R-3825-5
VOLUME II

TECHNICAL MANUAL

***MAINTENANCE AND REPAIR***

# J-2 ROCKET ENGINE
# GROUND SUPPORT EQUIPMENT

(ROCKETDYNE)

CHANGE NOTICE

**LATEST CHANGED PAGES SUPERSEDE THE SAME PAGES OF PREVIOUS DATE**

Insert changed pages into basic publication. Destroy superseded pages.

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PUBLISHED UNDER AUTHORITY OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

19 JANUARY 1967

CHANGE NO. 19 — 15 MARCH 1975

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Upon receipt of the second and subsequent changes to this technical manual, personnel responsible for maintaining this publication in current status will ascertain that all previous changes have been received and incorporated. Action should be taken promptly if the publication is incomplete.

**This page reflects the current status of the complete manual. All pages listed must be in the manual to make this publication current and complete.**

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# INTRODUCTION

This manual is one of the R-3825-series technical manuals prepared to provide official Rocketdyne field support documentation for the operation and maintenance of the J-2 Rocket Engine, Part Number 103826, Serial Numbers J-2046, J-2056, J-2062, J-2083, J-2087, J-2095, J-2103, J-2104, J-2107, J-2126 through J-2130, J-2132, J-2135 through J-2147, and J-2149 through J-2152, and its related ground support equipment, designed and manufactured by Rocketdyne Division, Rockwell International, 6633 Canoga Avenue, Canoga Park, California 91304. The information in these manuals was prepared by Logistics Product Support Department of Rocketdyne.

The manuals are used to best advantage when each manual is current and complete (see figure 1) and the purpose and scope of each manual is known. The manuals in this series, and the nature of the data each provides, are found in the contents and support function chart.

## 1. J-2 MANUALS--THEIR SUPPORT FUNCTIONS.

The contents and support function chart lists all J-2 series technical manuals, describes the support function of each manual, and lists the section titles of each manual. The chart also explains how the technical data in each manual relates to the support of the engine and its ground support equipment throughout a normal engine flow, as well as during unscheduled maintenance tasks. Information appearing in one manual is not duplicated in another. Thus, information on the description, operation, and maintenance of ground support equipment is in R-3825-5. However, the instructions for servicing the engine using ground support equipment are in R-3825-3 and R-3825-1B.

| Manual | Contents and Support Function | Section and Title |
|---|---|---|
| R-3825-1<br>J-2 Rocket Engine Data | This manual contains a description and theory of operation of the engine, its systems, and its components; mass properties and design load criteria, including engine weight, gimbaled mass, center of gravity, and moment of inertia for the basic engine and its accessories; and customer connections. | I Description and Operation<br>II through VII Deleted<br>VIII Performance<br>IX Mass Properties and Design Load Criteria<br>X Electrical System Interface Data<br>XI Instrumentation System Interface Data<br>XII Customer Connections |
| R-3825-1B<br>J-2 Rocket Engine Operating Instructions Supplement | This manual contains authorized field operating requirements that affect flight engines during their normal flow from engine receipt through vehicle launch, and those procedures recommended by Rocketdyne that support these requirements most effectively. All specific and general requirements for activities to be performed and acceptability criteria for these activities are included along with the limits, special constraints, safety precautions, and correct sequences required to satisfactorily accomplish the activities. | I Operating Requirements<br>II General Requirements<br>III Operating Procedures |

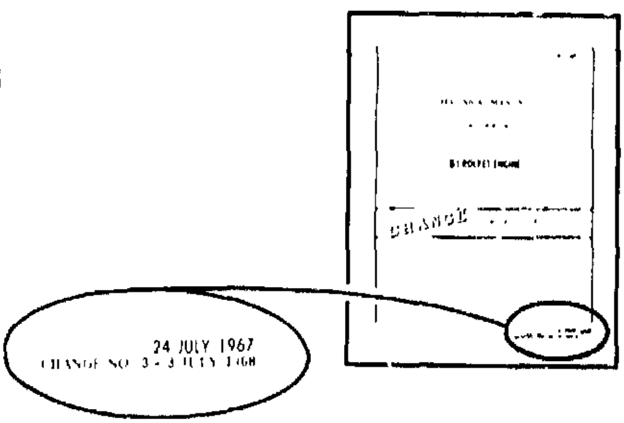
| Manual | Contents and Support Function | Section and Title | |
|---|---|---|---|
| R-3825-3, Volume I J-2 Rocket Engine Maintenance and Repair | This manual contains requirements and procedures for handling; component removal and installation; cleaning; post-maintenance test requirements; the safety precautions to be observed; and information on the tools, materials, electrical power, and pressurizing agents necessary to perform the tasks. | I | General Maintenance and Repair |
| | | II | Handling |
| | | III | Component Removal and Installation |
| | | IV | Post-Maintenance Test Requirements |
| | | V | Preparation of Components Handler Equipment for Use |
| | | VI | In-Place Tube Welding |
| R-3825-3, Volume II J-2 Rocket Engine Maintenance and Repair | This manual contains requirements and procedures for component bench testing and repair; the safety precautions to be observed; and information on the tools, materials, electrical power, and pressurizing agents necessary to perform the tasks. | I | Air Filler Valve |
| | | II | Armored Harness |
| | | III | Augmented and Gas Generator Spark Igniter Cables |
| | | IV | Electrical Control Assembly |
| | | V | Flight Instrumentation Packages |
| | | VI | Fuel Turbopump |
| | | VII | Heat Exchanger |
| | | VIII | Helium Fill Check Valve |
| | | IX | Ignition Detector Probe |
| | | X | Insulation |
| | | XI | Integral Hydrogen-Helium Start Tank |
| | | XII | Mainstage OK Pressure Switch |
| | | XIII | Oxidizer Turbopump |
| | | XIV | Purge and Seal Drain Check Valves |
| | | XV | Solenoid Valves |
| | | XVI | Start Tank Discharge Valve |
| | | XVII | Start Tank Refill Check Valve Manifold 307599-41 |
| | | XVIII | Start Tank Support and Fill Valve |
| | | XIX | Thrust Chamber |
| | | XX | Transducers |
| | | XXI | Vent Port Check Valves |

| Manual | Contents and Support Function | Section and Title | |
|---|---|---|---|
| R-3825-4<br>J-2 Rocket Engine Illustrated Parts Breakdown | This manual contains related illustrations and columnar listings of all parts of the engine that can be replaced at field sites as determined by the maintenance concept; definitions and designations of source, maintenance, repairability, interchangeability, and usable-on codes; information pertaining to retrofit modifications; identification of next higher assemblies; and identification of reference designation numbers. | I<br>II<br>III | Introduction<br>Group Assembly Parts List<br>Numerical Index |
| R-3825-5,<br>Volume I<br>J-2 Rocket Engine Ground Support Equipment Maintenance and Repair | This manual contains a description of engine servicing, handling, and test equipment; procedures for performing maintenance and checkout tasks; and inspection and maintenance requirements tables. | I<br>II<br>III<br>IV<br>V<br>VI<br>VII<br>VIII<br>IX<br>X<br>XI<br>XII<br>XIII<br>XIV<br>XV | General Maintenance and Repair<br>Thrust Chamber Throat Plug Kit G3120<br>Thrust Chamber Protective Pad 9016705<br>Electrical Checkout Console G1037<br>Flight Instrumentation Checkout Console G1035<br>Data Recorder Console G3121<br>Engine Test Plates, Adapters, and Tools<br>Extended Range Vibration Safety Cutoff Set G1038<br>Pneumatic Console G3106<br>Pneumatic Flow Tester G3104<br>Simulator Panel 9024480-11<br>Components Test Console G3107<br>Automatic Inert Gas Arc Welding Set G3128<br>Single Head Special Tool Kit G3127<br>Propellant Utilization Valve Voltage Adjust and Monitoring Test Unit 9025664 |
| R-3825-5,<br>Volume II<br>J-2 Rocket Engine Ground Support Equipment Maintenance and Repair | This manual contains a description of engine servicing, handling, and test equipment; procedures for performing maintenance and checkout tasks; and inspection and maintenance requirements tables. | See table of contents for this volume. | |

USE YOUR MANUAL ONLY IF CURRENT AND COMPLETE

Manuals that are not current and complete are not authoritative documents and are not to be used. The following outlines the method for determining whether your manual is current and complete.

A. DETERMINING CURRENCY. To be sure that yours is the latest issue of the manual, refer to Configuration Identification & Status Report , which is revised monthly and lists the technical manual numbers, titles, unincorporated supplements, and latest change or revision dates. Your manual must have a title page with the same or later date than the date shown in the Configuration Identification & Status Report. Your manual must also include the unincorporated supplements listed in the Configuration Identification & Status Report, or if your manual is later than shown in the report, the unincorporated supplements listed in the Manual Data Supplement Record in your manual. If your title page incorporates two dates as illustrated below, compare the change (lower) date. If your manual is not current, obtain a current copy through your technical manual supply system.

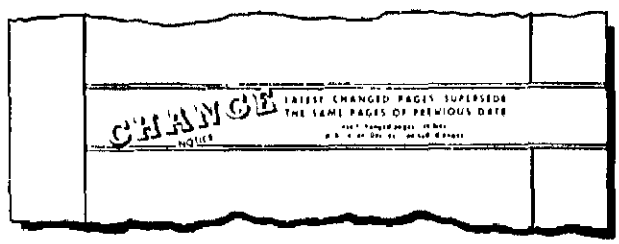



B. DETERMINING COMPLETENESS. To be sure that your manual is complete, make a page-by-page comparison of its pages to those listed in the List of Effective Pages. The List of Effective Pages, which shows the change status since the basic issue or last revision, is found on the alphabetically lettered page(s) immediately following the title page. All pages, except supplements, are listed with their issue dates. Manual pages that are dated must have the same date as that appearing in the List of Effective Pages for that page. Unchanged pages are listed as "original" and are not dated.

HOW TO KEEP YOUR MANUAL UP-TO-DATE

As design changes are made to the rocket engine and ground support equipment and better methods of maintenance are discovered, your manual is periodically changed, revised or supplemented. The following steps will help you keep your manual up-to-date:

A. CHANGES. Updating by adding to or partially replacing existing pages is defined as a change. Changes can be identified by the change notice on the new title page.




To collate a change, refer to the Filing Instructions sheet issued with the manual and proceed as follows:

1. Remove the pages listed in the "Remove" column of the Filing Instructions sheet from the manual and destroy them. Do not concern yourself with the data on the opposite side of the deleted page since, if this date is not deleted, it is replaced in the change package.

2. Insert all pages listed in the "Insert" column of the Filing Instructions sheet in sequence. Pages with a suffix letter are inserted in alphabetical order following the page with the same basic number; for example, pages 3-14A, 3-14B, etc, follow page 3-14.

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Figure 1. How to Maintain Your Manual (Sheet 1 of 2)

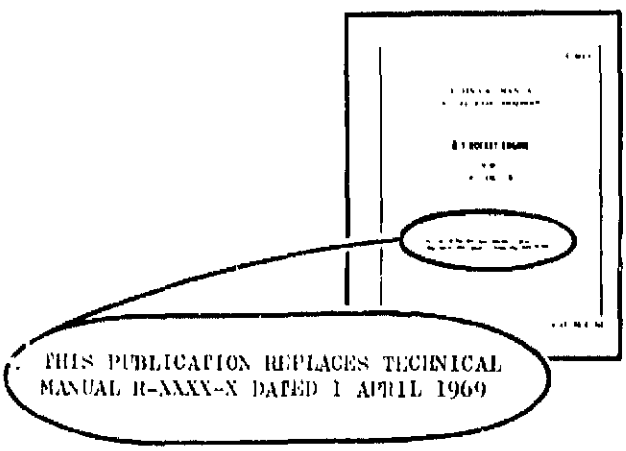
3. If you are unsure of the status of any page or pages, refer to the List of Effective Pages and make sure your manual contains pages (with the corresponding change dates) listed in the List of Effective Pages.

4. Remove manual supplements that have been incorporated.

NOTE

Incorporated supplements can be determined by reviewing the newly issued Manual Data Supplement Record.

B. REVISIONS. Updating by replacing all the existing pages of a manual is defined as a revision. Revisions can be identified by the replacement notice on the new title page.




To collate a revision, proceed as follows:

1. Remove and destroy all existing pages of your manual except Manual Data Supplements that have not been incorporated.

NOTE

Unincorporated supplements can be identified by reviewing the Manual Data Supplement Record supplied in the revision.

2. Insert the new pages in your cover.

C. SUPPLEMENTS. Updating that authorizes the addition to, or alteration of, the existing data in your manual is defined as a Manual Data Supplement. Information on how to insert supplements is found in the supplements.

HOW TO KEEP ABREAST OF THE LATEST CHANGES TO TECHNICAL DATA

Changes and/or additions to technical data are identified by a vertical bar (change bar) in the margin of the page adjacent to the changed data. A direct comparison between the new (identified by the change bar) and the old data will help you in identifying specific changes made.

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Figure 1. How to Maintain Your Manual (Sheet 2 of 2)

## 2. CONFIGURATION IDENTIFICATION.

EQUIPMENT CONFIGURATION. The MD identification symbol and the equipment model designation indicate the configuration of the equipment and distinguish it from models incorporating different changes and from basic models. A basic, unchanged configuration of the equipment has no MD identification symbol. MD identification symbols are added as changes affecting configuration are incorporated into the equipment. The MD identification symbol is stamped on the MD plate, which is mounted near the equipment nameplate.

MD IDENTIFICATION SYMBOLS. The MD identification symbol is a composite number representing all the changes affecting configuration (MD changes) that are incorporated or not incorporated into the equipment. The symbol represents a consecutively numbered series of MD changes. Any MD change, or series of MD changes, not incorporated is represented by an "X." Multi-digit numbers are underlined. Two figures together represent the limits of a series of incorporated MD changes. Figure 2 illustrates how MD changes incorporated in the equipment are represented by the MD identification symbol.

MANUAL REFERENCE. A reference that appears in the manual may refer to a series of MD changes or to an individual MD change; for example, "MD9" refers to MD1 through MD9, but "MD9 change" refer to the individual MD change 9. This latter type of reference, which is illustrated in figure 2, identifies separate sets of information required by differences in configuration. When an MD reference appears in this manual, examine the MD identification symbol on the equipment to determine which set of information is applicable.

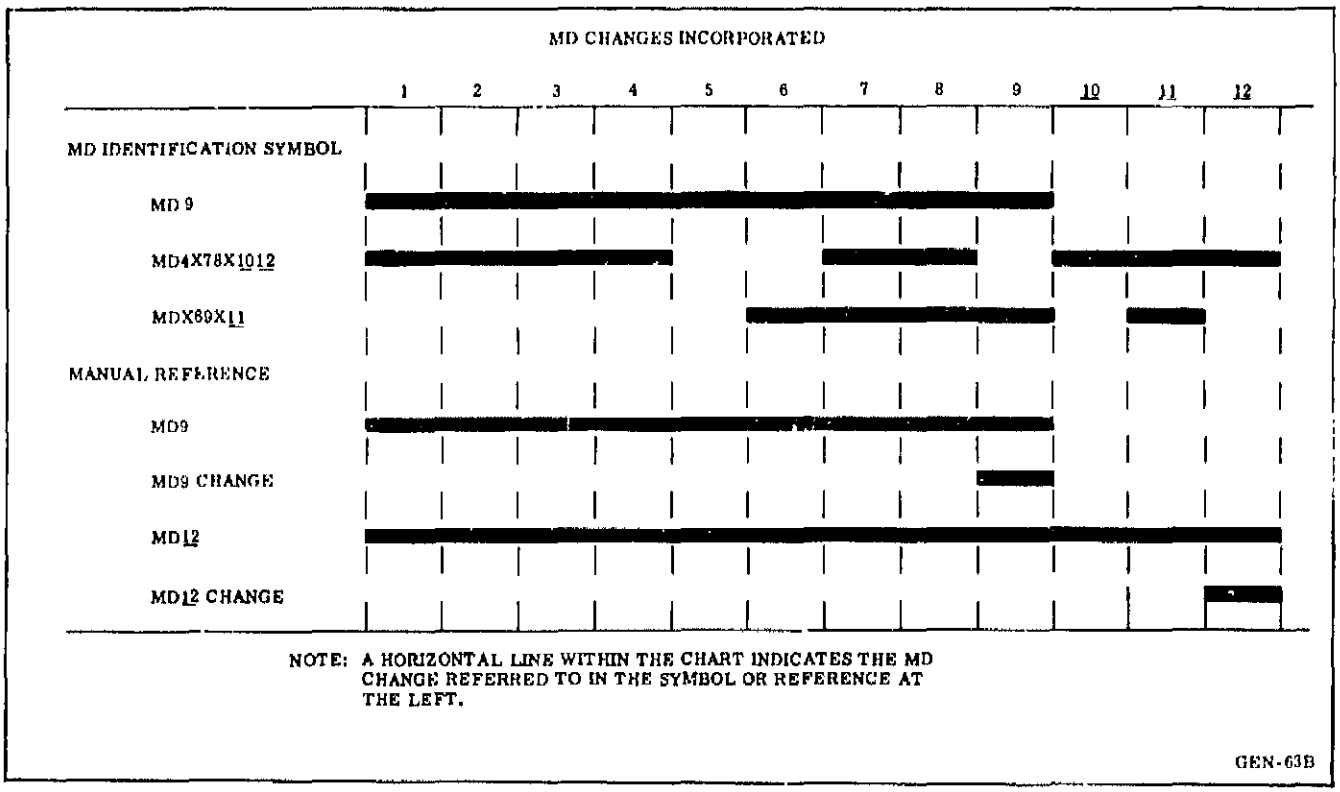


Figure 2. MD System

3. CONFIGURATION CHANGES--MANUAL EFFECTIVITY.

All approved ECPs (Engineering Change Proposals) applicable to the equipment covered in this volume are listed in the Configuration Changes--Manual Effectivity figure of the applicable section when the ECP is incorporated in the manual. This figure includes the associated MD or part dash number and the publication date of the volume in which the ECP was incorporated. Should an approved ECP not affect the data, N/A is entered in the publication date column. GSE configuration information and GSE serial number allocation are in R-5788, Saturn J-2 Configuration Identification & Status Report.

4. DATA BASIS.

This volume provides the data needed to acquaint the user with the hardware and to enable him to perform the maintenance tasks dictated by the needs of the hardware and recommended for field performance by the maintenance concept reflected in R-8842, Maintenance and Support Plan for Saturn F-1, H-1, and J-2 Rocket Engines. Specific references to the related manual containing the operational data are made in the applicable sections. Planned maintenance requirement data is not intended to limit the level of repair of vendor hardware when such repair or minor part replacement can correct the defect, has no detrimental effect on the safety or performance of the end item and its components, and has the concurrence of Rocketdyne Engineering.

# SECTION I

## MISCELLANEOUS TOOLS



Underlined titles denote primary paragraphs.

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(continued)



1-1. SCOPE. This section describes the purpose and use, illustrates, and provides maintenance data to support field level maintenance of miscellaneous tools.

1-2. GENERAL INFORMATION.

1-3. This section is arranged in an alpha-numerical sequence by part number. An individual paragraph for each tool describes the purpose and use of the tool. Where applicable, each of these paragraphs includes the tasks anticipated or required for field level maintenance of the tool. The absence of maintenance data in a paragraph indicates that maintenance is not required or anticipated for the tool; however, it is possible that maintenance will be unavoidable. Such maintenance is acceptable with concurrence of Rocketdyne representative. To eliminate redundancy, cleaning that is required for all tools is not listed as a maintenance task. Tools must be cleaned, as required, in accordance with cleaning requirements in R-3825-5, Volume I. To aid in identification and servicing, each tool is illustrated. Dimensions on these illustrations are aids for identification and are not to be used as acceptance or rejection criteria.

1-4. HEAT EXCHANGER ORIFICE RETENTION TOOL CLIP EWR-116615-1.

1-5. The heat exchanger orifice retention tool clip (figure 1-1) is used to retain individual heat exchanger inlet orifice plates and/or blanking plates from the effect of gravity during installation. As each orifice or blanking plate is installed a retention tool clip is attached to the inlet manifold flange to retain the plate. The retention tool clips are removed when all plates are installed and are being retained by the heat exchanger inlet filter installation spring. Clips can be reformed and on clips made of carbon steel, tape can be replaced as necessary. P421 Teflon tape (Johnson and Johnson, Inc), or equivalent is to be used. Instructions for the use of the orifice retention tool clip are in R-3825-3.

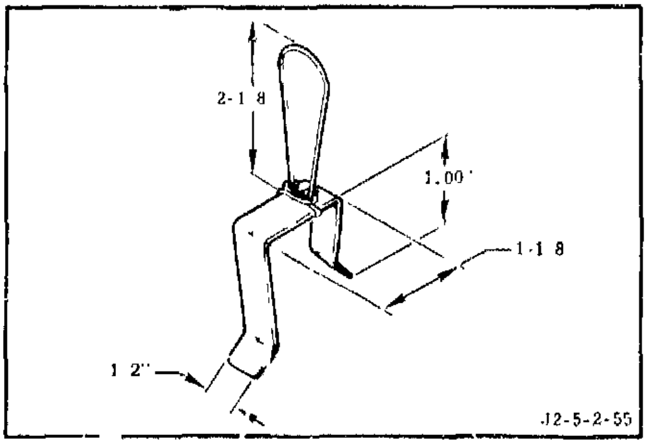



Figure 1-1. Heat Exchanger Orifice Retention Tool Clip EWR-116615-1

1-6. HEAT EXCHANGER ORIFICE RETENTION TOOL SPRING EWR-116615-2.

1-7. The heat exchanger orifice retention tool spring (figure 1-2) is used to retain the heat exchanger inlet orifice plates and/or blanking plates from the effect of gravity during installation. The spring is wound through the screen of the inlet filter and acts as a compressible extension that maintains pressure on the plates, holding them in place while the filter is installed. With the filter installed, the spring is wound through the filter screen and removed. Distorted coils can be reformed. Instructions for the use of the orifice retention tool spring are in R-3825-3.

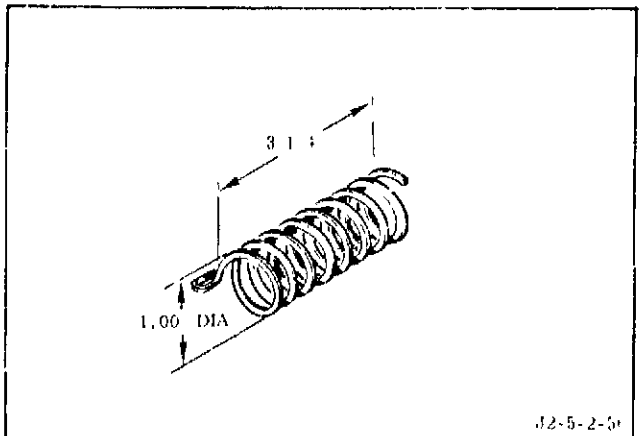



Figure 1-2. Heat Exchanger Orifice Retention Tool Spring EWR-116615-2

1-8. STDV SWING GATE TEST PLATE GASKET EWR-129666.

1-9. The STDV swing gate test plate gasket (figure 1-3) is used when vacuum-drying the engine start tank system. The gasket seals a test plate mounted on the start tank discharge valve outlet flange; the protrusion on the inside diameter of the gasket (inserted under the swing gate) holds the gate partially open. The test plate gasket can be repaired (paragraph 1-10) by cementing debonded rubber. Instructions for the use of the test plate gasket are in R-3825-1B.

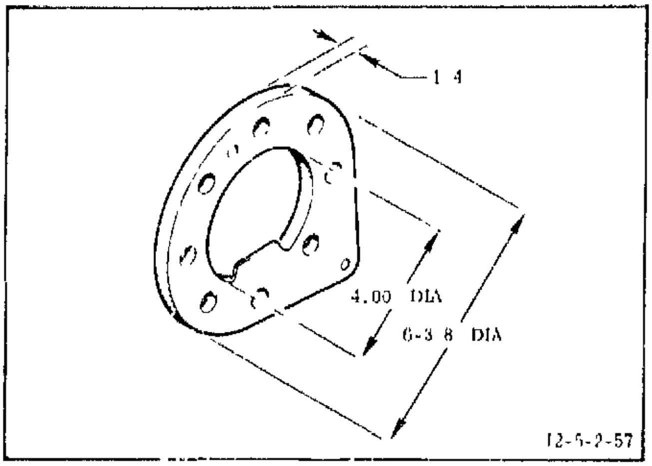



Figure 1-3. STDV Swing Gate Test Plate Gasket EWR-129666

1-10. REPAIRING STDV SWING GATE TEST PLATE GASKET.

1-11. Field repair of the STDV swing gate test plate gasket consists of cementing rubber sections that have debonded. Cement the test plate gasket as follows:

WARNING

The following procedure specifies toluene which is flammable and must not be used near heat, sparks, or open flame. It is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

a. Obtain the following materials:

(1) Commercially available abrasive cloth or paper of suitable grit to abrade rubber.

(2) Toluene (Federal Specification TT-T-548).

(3) Adhesive 584 (Coast Pro-Seal).

(4) Cloths and brushes to wipe surfaces and apply adhesive.

b. Abrade debonded surfaces to roughen and remove contaminants. Existing adhesive that is firmly bonded to the rubber need not be removed.

c. Wipe abraded surfaces with toluene.

WARNING

The following specifies adhesive 584, which is flammable and must not be used near heat, sparks, or open flame. It is toxic. Inhalation of its vapors or prolonged contact with the adhesive can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

d. Brush one thin even coat of adhesive (approximately 1-2 mils thick) on each surface to be bonded.

e. Allow adhesive to become tacky (adhesive does not adhere to finger when touched) approximately 30 minutes. If adhesive is allowed to become tack-free, wipe adhesive on one surface with toluene.

f. Press surfaces firmly together and roll from center to edges so that surfaces adhere and air bubbles are removed.

g. Allow gasket to set a minimum of 24 hours before use.

1-12. ASI CHAMBER BLOCKING DEVICE EWR-151821.

1-13. The ASI chamber blocking device (figure 1-4) is used to muffle the sound interference from the ASI spark igniters to be able to hear the GG spark igniter operate. The blocking device is manually held against the ASI chamber port to muffle the sound coming from the ASI spark igniters. The tip can be replaced as necessary. Instructions for the use of the blocking device are in R-3825-1B.

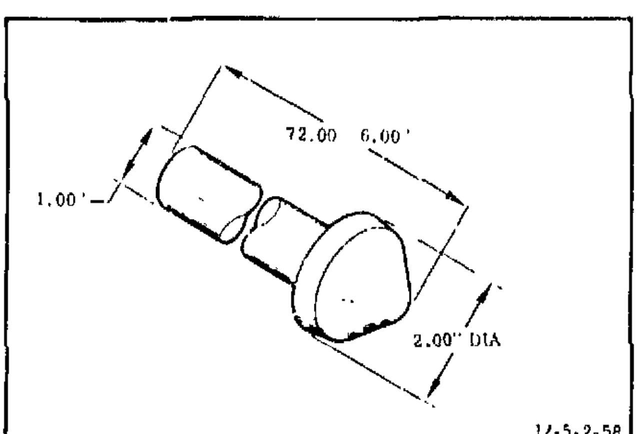



Figure 1-4. ASI Chamber Blocking Device EWR-151821

1-14. FLUID LEVEL EWR-151822.

1-15. The fluid level (figure 1-5) is used when leveling the engine during use of the engine lowering systems in Engine Components Installers G4071 or G4072. The level is placed on the oxidizer dome and used as a reference to level the engine in the x and z axes. Instructions for the use of the level are in R-3825-3.

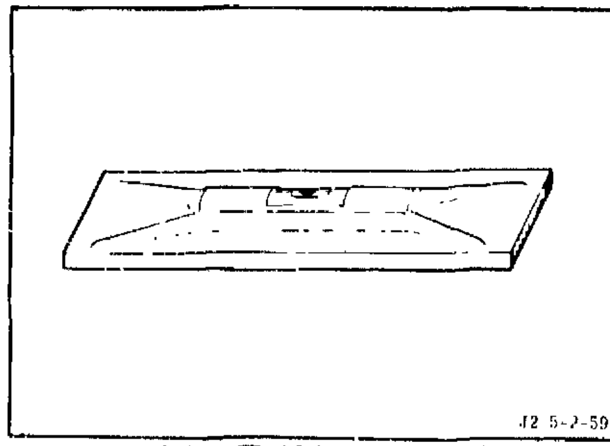


Figure 1-5. Fluid Level EWR-151822

1-16. MRCV AND GG VALVE DRYING AND LEAK TEST KIT EWR-230094.

1-17. The MRCV and GG valve drying and leak test kit EWR-230094 consists of universal fitting housing EWR-168312, universal fitting bolt EWR-168313, one O-ring MS28778-5, and one O-ring AN6227-8 (figure 1-6). The kit is used when vacuum-drying the gas generator valve and the mixture ratio control valve linkage cavity. The fitting replaces the gas generator valve and the mixture ratio control valve vent port check valves, and a vacuum pump attached to the universal fitting housing dries the valves. Minor thread damage can be corrected by chasing threads with a 7/16-20 UNF-3A die. Minor damage and scratches can be removed from sealing surfaces by polishing. Instructions for the use of the kit are in R-3825-1B.

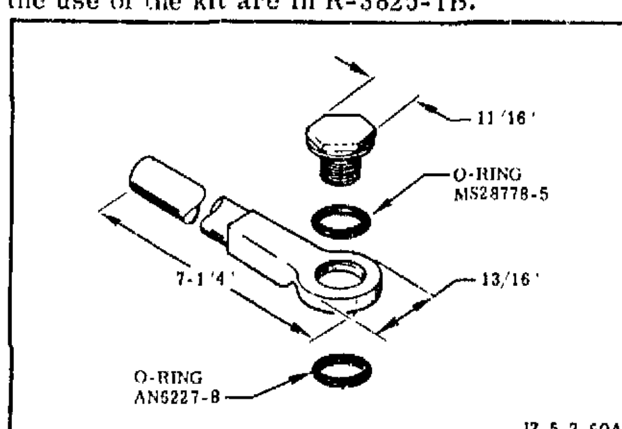



Figure 1-6. MRCV and GG Valve Drying and Leak Test Kit EWR-230094

1-18. TAPE INSTALLATION NEEDLE EWR-172554.

1-19. The tape installation needle (figure 1-7) is used as an aid in routing tape behind and around the fuel bleed line and bracket when insulating these items. The tape is threaded through the eye of the needle, and the needle is then used to guide and route the tape. Instructions for the use of the needle are in R-3825-3.

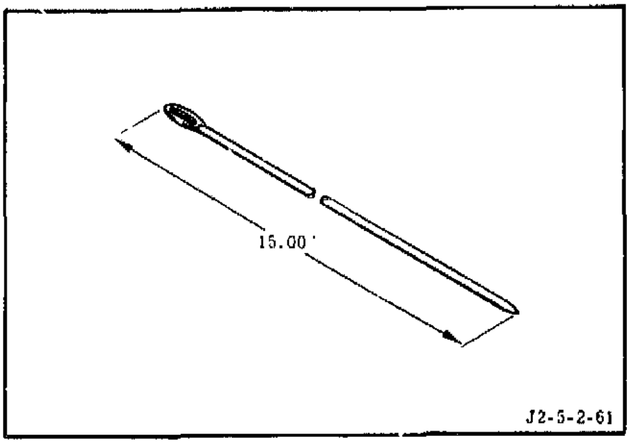



Figure 1-7. Tape Installation Needle EWR-172554

1-19A. ADAPTER SET EWR-181886.

1-19B. The adapter set (figure 1-7A) is used to test the start tank vent-and-relief valve. The set can test three start tank vent-and-relief valve control line configurations. The three configurations are a new valve, and valves that have been removed once or twice with the control line cut and shortened with each removal. Minor thread damage can be corrected by chasing the threads, and damaged anodized coating can be repaired (refer to repairing chemical film in R-3825-5, Volume I).

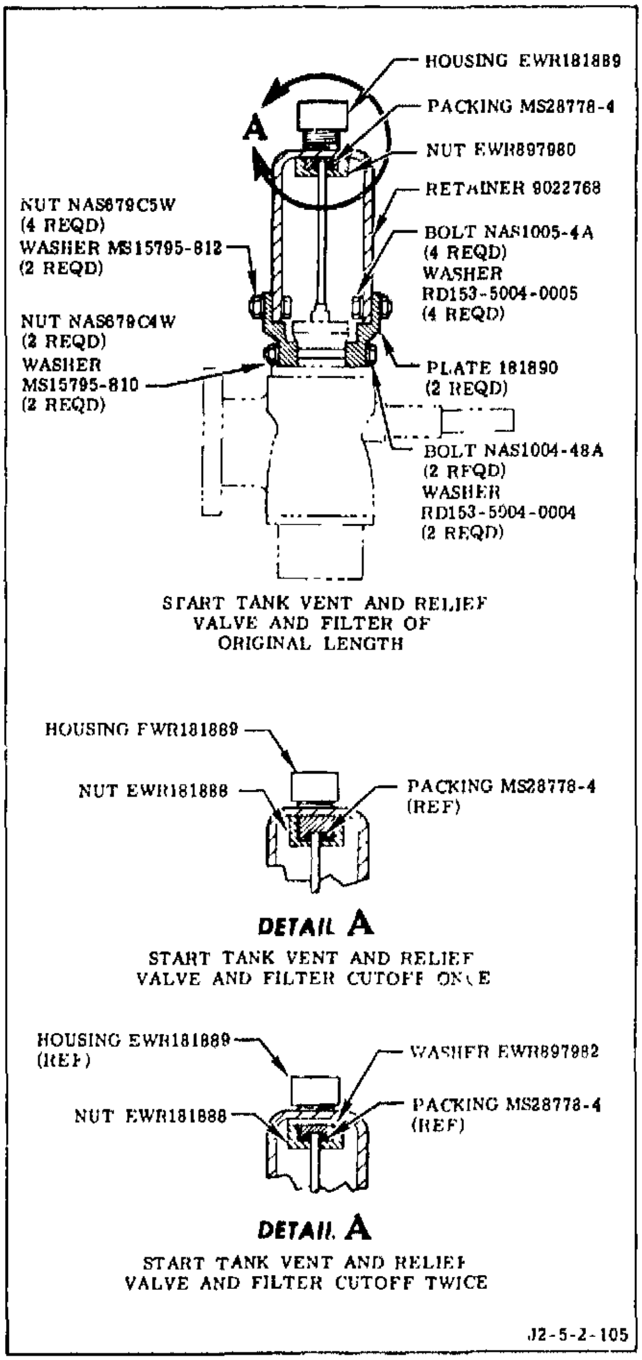



Figure 1-7A. Adapter Set EWR-181886

## 1-20. SPACER EWR-183366.

1-21. The spacer (figure 1-8) is used to hold the fuel inlet duct partially compressed to permit installation of the fuel inlet duct handler during removal and/or installation of the duct when the engine is installed in an SIVB stage. During removal, the duct is disconnected from the stage mating flange and compressed, the spacer is inserted between the duct and the stage mating surface, and the duct is allowed to extend. With the spacer between the duct and the stage, the inlet duct is compressed sufficiently to install the duct handler. The procedure is reversed to install the duct. Instructions for the use of the spacer are in R-3825-3.

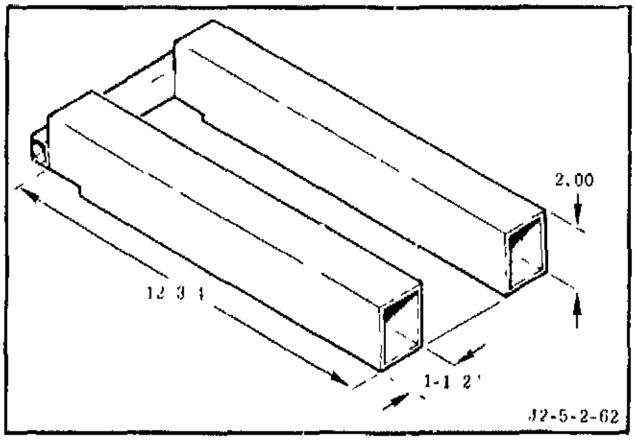



Figure 1-8. Spacer EWR-183366

## 1-22. TORQUE WRENCH EWR-183382.

1-23. The torque wrench (figure 1-9) is used to apply the torque when installing a mixture ratio control valve vent port check valve. Instructions for the use of the torque wrench are in R-3825-3.

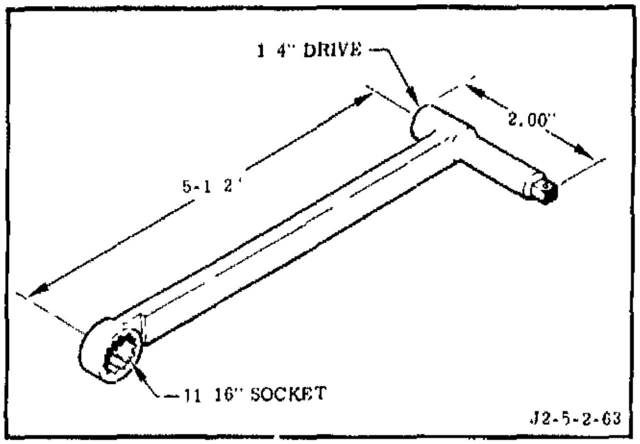



Figure 1-9. Torque Wrench EWR-183382

## 1-24. ADAPTER EWR-183647.

1-25. The adapter (figure 1-10) is used with pressure test fixture T-5047149 (figure 1-36) to test the start tank refill check valve. The adapter provides the capability to seal and apply pressure to the open tube end of the start tank refill check valve. Minor thread damage can be corrected by chasing threads with a 9/16-18 UNJF-3B tap. Minor damage and scratches can be removed from sealing surfaces by polishing. Corrosion must be cleaned from the adapter as required (refer to R-3825-5, Volume I). Instructions for the use of the adapter are in R-3825-3.

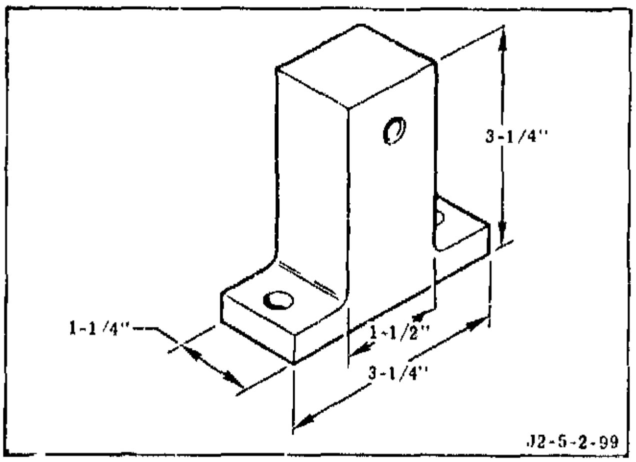



Figure 1-10. Adapter EWR-183647

1-25A. PEDESTAL EWR-183649.

WARNING

The following specifies zinc chromate primer, which is flammable and must not be used near heat, sparks, or open flame. It is toxic. Inhalation of its vapors or prolonged contact with the primer can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

1-25B. The pedestal (figure 1-10A) replaces the casters on Engine Handler G4064 when engine on handler is in cocoon. The pedestal eliminates the tires, which are flammable. Maintain finish with zinc chromate primer and standard yellow GSE finish coat.

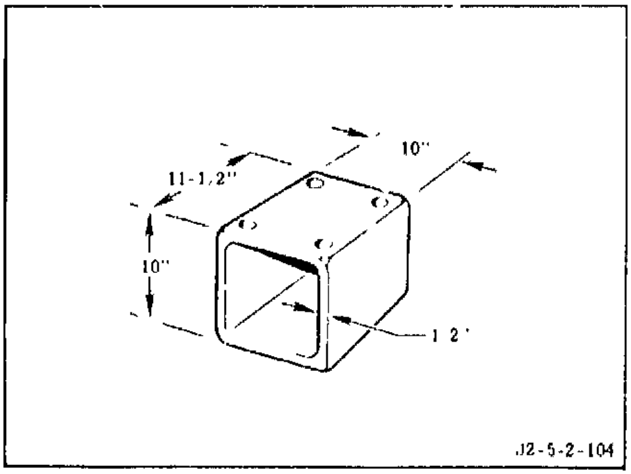



Figure 1-10A. Pedestal EWR-183649

1-25C. REDUNDANT TIMER ADAPTER EWR-220289.

1-25D. The redundant timer adapter EWR-220289 consists of a connector MS3100E20-27P with jumper wires interconnecting various terminals on the connector (see figure 1-10B for wiring diagrams). The redundant timer adapter is used during uninstalled engine sequence tests so that the ECA timer will be recorded on the oscillographs.

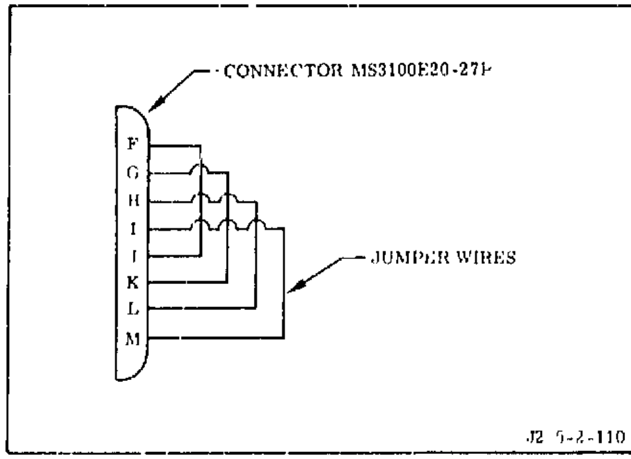



Figure 1-10B. Redundant Timer Adapter EWR-220289

1-25E. OTBV CLOSING LINE CLOSURE TEST KIT EWR-225308.

1-25F. The OTBV closing line closure test kit EWR-225308 consists of a test plate EWR-225307, a packing MS29513-012, 4 bolts RD111-1009-3418, 4 washers LD153-0013-0002, and 4 nuts RD114-002-0004 (see figure 1-10C). A streamer that cautions removal of the test plate before firing is attached to the test plate. The test plate is used to perform the OTBV closing line tests. Instructions for the use of the kit are in R-3825-1B.

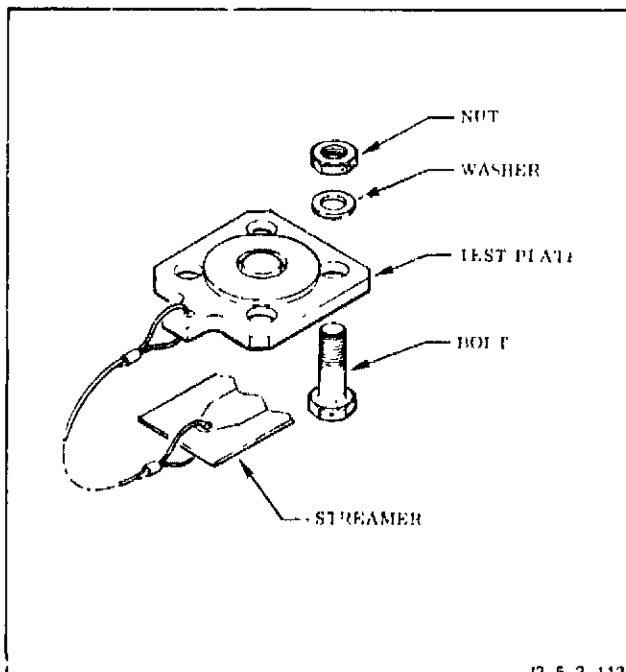



Figure 1-10C. OTBV Closing Line Closure Test Kit EWR-225308

1-25G. MOV, MFV, AND OTBV DRYING KIT EWR-225309.

1-25H. The MOV, MFV, and OTBV drying kit EWR-225309 consists of one each fitting AN807-4J or fitting AN838-4J, nut AN924-4L, and O-ring MS28778-4 (see figure 1-10D). The kit is used to interconnect valves during vacuum-drying of the propellant valves and oxidizer turbine bypass valve. Instructions for the use of the kit are in R-3825-1B.

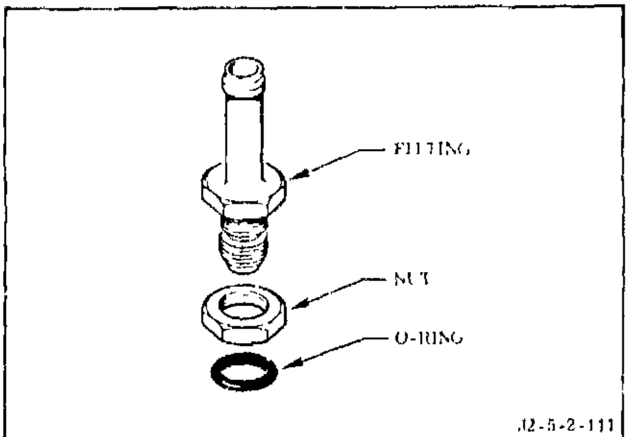



Figure 1-10D. MOV, MFV, and OTBV Drying Kit EWR-225309

1-25J. LEAK TESTING OXIDIZER FEED AND PURGE SYSTEMS KIT EWR-225310.

1-25K. Leak testing oxidizer feed and purge systems kit EWR-225310 contains STDV drain line test plate EWR-194759, which is used to block the STDV drain line at the exhaust manifold, 4 bolts RD111-1010-3424, 4 washers LD153-0013-0002, 4 nuts RD114-1002-0004, and one seal 404673-13 (see figure 1-10E). Repair the test plate by replacing protective surfaces (Teflon tape) as necessary. Use Permacel P422 tape (Johnson and Johnson, Inc) or 549 plastic film (Minnesota Mining and Mfg), 3.5 mil thick. Instructions for the use of the kit are in R-3825-1B.

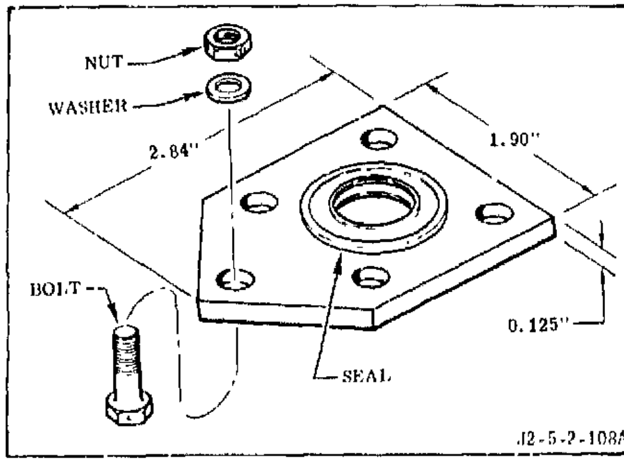



Figure 1-10E. Leak Testing Oxidizer Feed and Purge Systems Kit EWR-225310

1-26. FOLDED FIBERGLASS GUIDE EWR-680983.

1-27. The folded fiberglass guide (figure 1-11) is used as an aid in routing tape behind and around the fuel bleed line and bracket when insulating these items. The guide provides a nonadhering surface that prevents the tape from adhering to itself until it is properly positioned whereupon the guide is removed. Instructions for the use of the adapters are in R-3825-3.

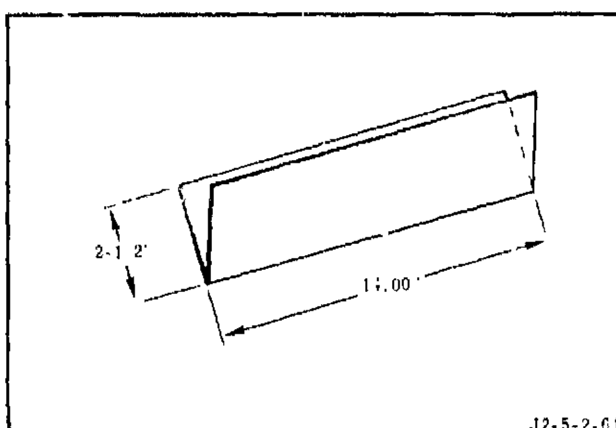



Figure 1-11. Folded Fiberglass Guide EWR-680983

1-28. ADAPTER EWR-828272-1 AND EWR-828272-2.

1-29. The adapters (figure 1-12) are used when proof-testing the engine lowering systems contained in Engine Components Installers G4071 and G4072. The adapters provide the capability of attaching the lowering systems to the proof-test weight. Instructions for the use of the adapters are in R-3825-5.

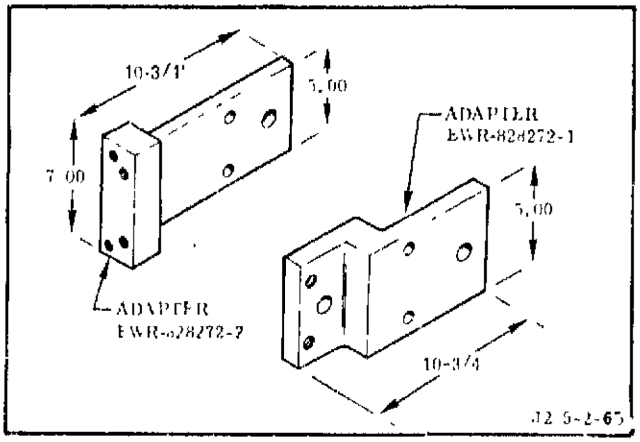



Figure 1-12. Adapter EWR-828272-1 and EWR-828272-2

1-30. SPLIT BARREL (FUEL) EWR-915725.

1-31. The split barrel (figure 1-13) is used with top plate EWR-915726 to protect the fuel turbopump from damage and/or contamination when removing or installing the fuel inlet duct. With the fuel inlet duct disconnected and compressed to clear the turbopump inducer, the split barrel is assembled on the turbopump inlet flange forming a barrier around the inducer. Damaged chemical film (refer to R-3825-5, Volume I) can be repaired and minor thread damage can be corrected by chasing threads with a 3/8-24 UNF-3B tap. Instructions for the use of the split barrel are in R-3825-3.

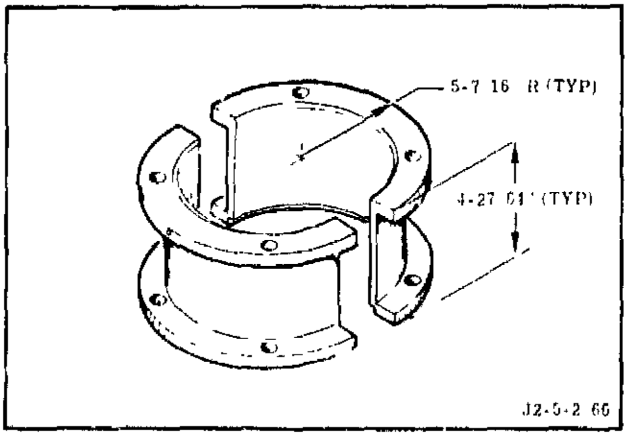



Figure 1-13. Split Barrel (Fuel)
EWR-915725

1-32. TOP PLATE (FUEL) EWR-915726.

1-33. The top plate (figure 1-14) is used with split-barrel (fuel) EWR-915725 to protect the fuel turbopump from damage and/or contamination when removing or installing the fuel inlet duct. After the split-barrel (fuel) is assembled on the turbopump, the top plate is attached to the top surface of the split-barrel to prevent objects from entering and damaging or contaminating the turbopump. Minor thread damage can be corrected by chasing threads with a 10-32 UNF-3B tap. Instructions for the use of the top plate are in R-3825-3.

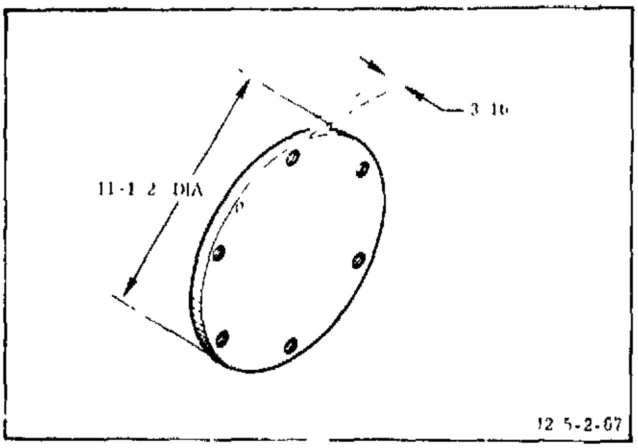



Figure 1-14. Top Plate (Fuel) EWR-915726

1-34. SLIDE SHEET (FUEL AND LOX) EWR-915729.

1-35. The slide sheet (figure 1-15) is used to protect surfaces that have relative movement when removing or installing the fuel or oxidizer inlet ducts. After protective devices are installed on the inlet duct and the turbopump, the slide sheet is placed between the two components to provide protection from damage due to accidental contact. Instructions for the use of the slide sheet are in R-3825-3.

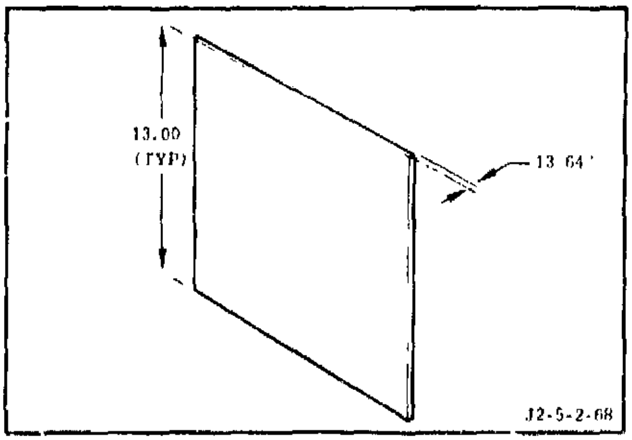



Figure 1-15. Slide Sheet (Fuel and LOX)
EWR-915729

1-36. <u>TORQUE ADAPTER EWR-937278.</u>

1-37. The torque adapter (figure 1-16) is used to torque the pressurizing valve core. Corrosion must be cleaned from the torque adapter as required (refer to R-3825-5, Volume I). Instructions for the use of the torque adapter are in R-3825-1B.

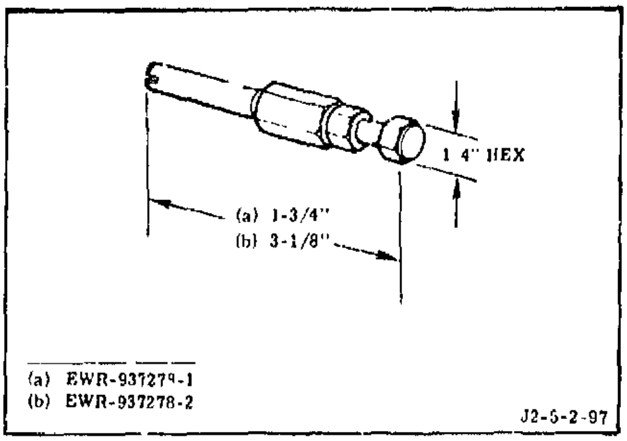



Figure 1-16. Torque Adapter EWR-937278

1-38. <u>BOTTOM PLATE (LOX DUCT) EWR-972056.</u>

1-39. The bottom plate (figure 1-17) is used when removing or installing the oxidizer inlet duct to protect the oxidizer inlet duct outlet flange. The bottom plate is mounted on the outlet flange of the oxidizer inlet duct to provide a physical barrier to aid in preventing damage to this surface. Minor thread damage can be corrected by chasing threads with a 5/16-24 tap. Instructions for the use of the bottom plate are in R-3825-3.

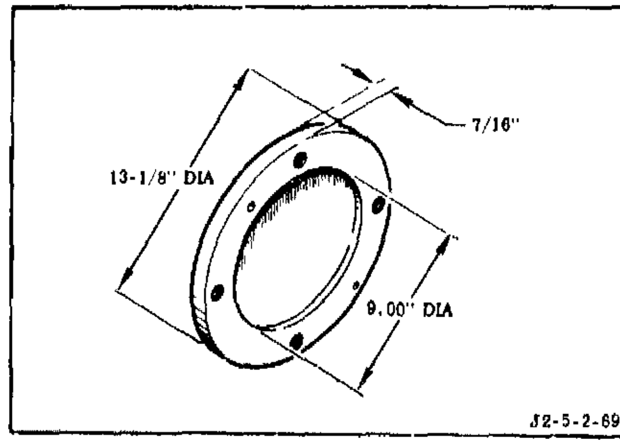



Figure 1-17. Bottom Plate (LOX Duct)
EWR-972056

1-40. <u>BOTTOM PLATE (FUEL DUCT) EWR-972057.</u>

1-41. The bottom plate (figure 1-18) is used when removing or installing the fuel inlet duct to protect the fuel inlet duct outlet flange. The bottom plate is mounted on the outlet flange of the fuel duct to provide a physical barrier to aid in preventing damage to this surface. Damaged anodized surface can be repaired (refer to repairing chemical film in R-3825-5, Volume I). Instructions for the use of the bottom plate are in R-3825-3.

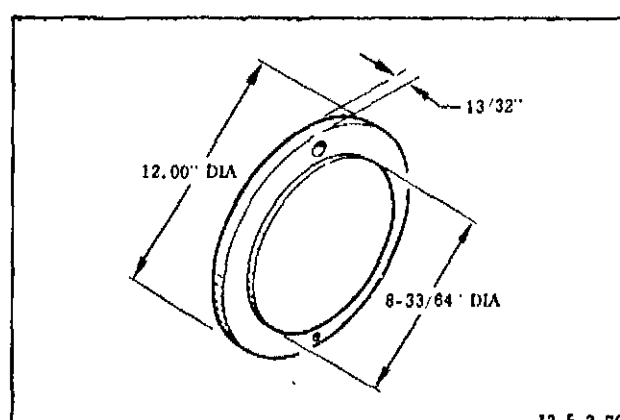
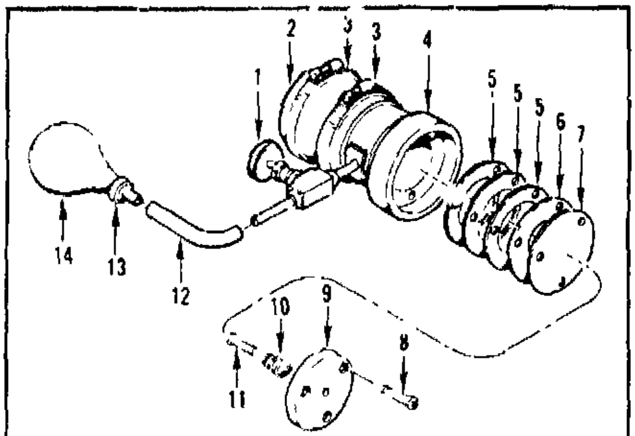



Figure 1-18. Bottom Plate (Fuel Duct)
EWR-972057

## 1-42. TEST FIXTURE KSC-J2-R066967.

1-43. The test fixture (figure 1-19) is used when testing the oxidizer turbopump primary seal drain line burst diaphragm for leakage. The test fixture is attached to the drain line, the ambient pressure within the line downstream of the burst diaphragm is lowered by the use of the bulb, and the area sealed by closing the valve. Any leakage past the burst diaphragm will be reflected by movement of the test indicator pin. Replace seals and refinish or replace sealing surfaces as necessary to maintain an acceptable leak-free condition. Minor thread damage can be corrected by chasing threads with an 8-32 NC-3B tap. Instructions for the use of the test fixture are in R-3825-1B.



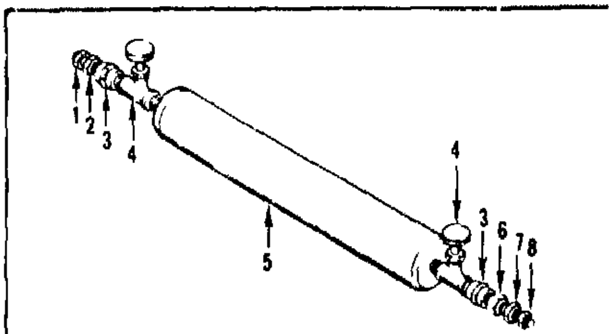

| INDEX NO. | PART NO. | QTY | DESCRIPTION |
|---|---|---|---|
| 1 | NO P N | | VALVE |
| 2 | 9025825 | | TYGON TUBE |
| 3 | AN737-TW48 | 2 | CLAMP |
| 4 | 551252 (MODIFIED) | | HIGH-PRESSURE RELIEF VALVE BODY |
| 5 | NO P N | 3 | SPACER |
| 6 | NO P N | | SPACER |
| 7 | NO P N | | DIAPHRAGM |
| 8 | AN507C832R8 | 3 | SCREW |
| 9 | 551960 | | HIGH-PRESSURE RELIEF VALVE SEAT |
| 10 | NO P N | | SPRING |
| 11 | NO P N | | INDICATOR PIN |
| 12 | NO P N | | TUBE |
| 13 | NO P N | | ADAPTER |
| 14 | 21 | | HYDROMETER BULB |

J2-5-2-71

Figure 1-19. Test Fixture KSC-J2-R066967

## 1-44. SPARK IGNITER CABLE GAS SAMPLE BOTTLE RL681000.

1-45. The spark igniter cable gas sample bottle (figure 1-20) is used when a spark igniter cable is discovered overpressurized (30 psig or greater). The sample bottle is evacuated and attached to the overpressurized cable, and a sample of the pressurizing gas is transferred to the sample bottle and analyzed. Replace seals and refinish or replace sealing surfaces as necessary to maintain an acceptable leak-free condition. Minor thread damage can be corrected by replacing the defective part. Tape must be applied (Method I, R-3825-5, Volume I) to male tapered pipe threads when replacing or reinstalling parts. Instructions for the use of the gas sample bottle are in R-3825-1B.




| INDEX NO. | PART NO. | QTY | DESCRIPTION |
|---|---|---|---|
| 1 | AN929-4S | | CAP |
| 2 | AN816-4S | | NIPPLE |
| 3 | AN910-2S | 2 | COUPLING |
| 4 | V139-1 4SS[a][c] | 2 | NEEDLE VALVE |
| 5 | 32112[b][c] | | GAS CYLINDER |
| 6 | AN912 1S | | BUSHING |
| 7 | AN816-2S | | NIPPLE |
| 8 | AN929 2S | | CAP |

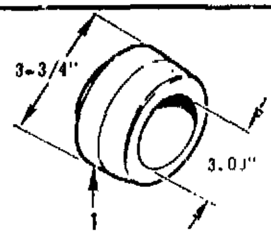
(a) REPUBLIC MFG CO.
(b) VAN WATERS AND ROGERS INC.
(c) OR EQUIVALENT.

J2-5-2-72

Figure 1-20. Spark Igniter Cable Gas Sample Bottle RL681000

## 1-46. SEAL PILOT T-5024739.

1-47. The seal pilot (figure 1-21) is used to guide the fuel turbopump turbine seal onto the fuel turbopump turbine ring. The lip at the large diameter end alines the seal pilot with the turbine ring. The turbine seal is then pushed over the tapered smooth outer surface of the pilot onto the turbine ring. Instructions for the use of the seal pilot are in R-3825-3.




| INDEX NO. | DETAIL NO. | DESCRIPTION |
|---|---|---|
| 1 | 101 | SEAL PILOT |
| | 103(a) | PLATE |
| | 104(a) | CONTAINER |

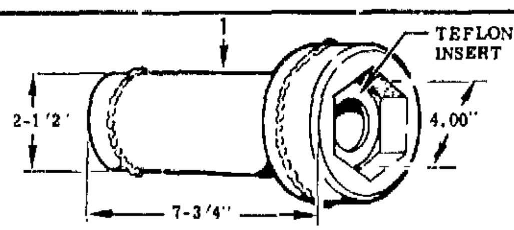
(a) ITEM NOT ILLUSTRATED.

J2-5-2-73

Figure 1-21. Seal Pilot T-5024739

## 1-48. SPECIAL SOCKET T-5026253.

1-49. The special socket (figure 1-22) is used to torque the oxidizer turbopump bearing nut. When cleaning this tool, note that it contains a press-fit Teflon insert, and use the appropriate cleaning procedure. Instructions for the use of the special socket are in R-3825-3.




| INDEX NO. | DETAIL NO. | DESCRIPTION |
|---|---|---|
| 1 | 110 | WELD ASSEMBLY |
| | 104(a) | PLATE |
| | 105(a) | CONTAINER |

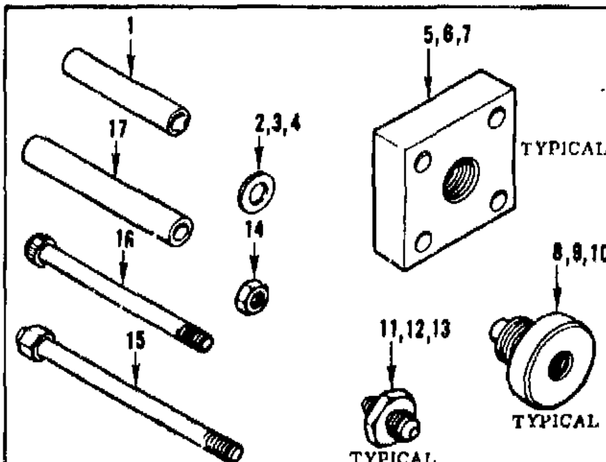
(a) ITEM NOT ILLUSTRATED.

J2-5-2-74

Figure 1-22. Special Socket T-5026253

## 1-50. PRESSURE TEST FIXTURE T-5029429.

1-51. The pressure test fixture (figure 1-23) is used to test the helium fill check valve. The test fixture is assembled on the valve and provides the capability to seal and apply pressure to the open tube ends of the valve. Minor thread damage can be corrected by chasing the threads with an appropriate size tap or die. Minor damage and scratches can be removed from sealing surfaces by polishing. Instructions for the use of the adapter are in R-3825-3.




| INDEX NO. | DETAIL NO. | QTY | DESCRIPTION |
|---|---|---|---|
| 1 | 508 | 4 | CRES PIPE |
| 2 | 505 | 2 | TEFLON O-RING |
| 3 | 512 | 2 | TEFLON O-RING |
| 4 | 520 | 2 | TEFLON O-RING |
| 5 | 502 | 2 | END PLATE |
| 6 | 511 | 2 | END PLATE |
| 7 | 601 | 2 | END PLATE |
| 8 | 501 | 2 | PRESSURE ADAPTER |
| 9 | 510 | 2 | PRESSURE ADAPTER |
| 10 | 602 | 2 | PRESSURE ADAPTER |
| 11 | 503 | 2 | NIPPLE (AN816-4-4C) |
| 12 | 517 | 2 | NIPPLE (AN816-6-6C) |
| 13 | 519 | 2 | NIPPLE (AN816-6-6J) |
| 14 | 506 | 4 | NUT (MS20500-624) |
| 15 | 514 | 4 | WELD ASSY |
| 16 | 507 | 4 | BOLT (NAS1006-70A) |
| 17 | 518 | 4 | CRES PIPE |
| | 504(a) | 3 | PLATE |
| | 513(a) | | CONTAINER |

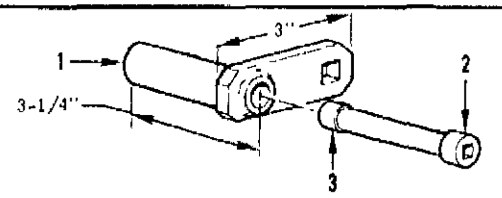
(a) ITEM NOT ILLUSTRATED.

J2-5-2-100

Figure 1-23. Pressure Test Fixture T-5029429

1-52. TORQUE TOOL T-5033142.

1-53. The torque tool (figure 1-24) is used to prevent the fuel turbine wheel studs from rotating when removing or installing nuts that secure the second-stage turbine wheel. The welded assembly engages the nut to be removed, and the socket with the extension is inserted into the hollow welded assembly to engage the stud. The extension and socket is maintained stationary to hold the stud, while the welded assembly is rotated, when removing or installing the nuts. Instructions for the use of the torque tool are in R-3825-3.




| INDEX NO | DETAIL NO. | DESCRIPTION |
|---|---|---|
| 1 | 201 | WELD ASSEMBLY |
| 2 | 205 | EXTENSION |
| 3 | 204 | SOCKET |
| | 206(a) | PLATE |
| | 207(a) | CONTAINER |

(a) ITEM NOT ILLUSTRATED.

J2-5-2-75

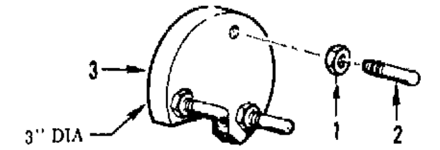
Figure 1-24. Torque Tool T-5033142

1-54. CHECK TOOL T-5033143.

1-55. The check tool (figure 1-25) is used to check the elongation of the turbine wheel studs when installing the turbine wheels. The check tool is placed adjacent to the stud to be measured and is used as a reference surface to measure stud elongation before and after torquing. This tool requires calibration that is the same as check tool 9021820 (refer to section XXV). Instructions for the use of the check tool are in R-3825-3.

1-56. WHEEL PULLER T-5035008.

1-57. The wheel puller (figure 1-26) is used to separate the oxidizer turbopump first- and second-stage turbine wheels when the wheels are removed from the turbine. The studs and push rods are alternately installed in boltholes in the turbine wheels and locked inplace with the locks. The base and plate are then assembled over the studs and secured with the wingnuts. Rotating the bolt into the plate applies pressure against the push rods causing the turbine wheels to separate. Minor thread damage can be corrected by chasing threads with a tap or die. The plate and the bolt are 1/2-13 thread and the studs and wingnuts are 5/16-18 thread. Instructions for the use of the wheel puller are in R-3825-3.

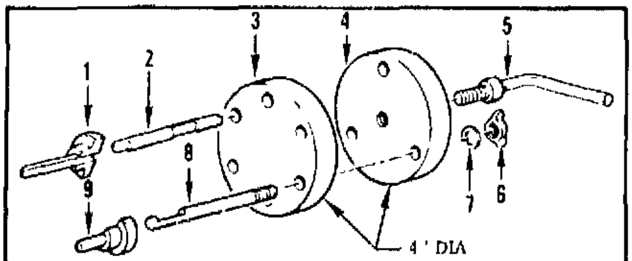



| INDEX NO. | DETAIL NO. | QTY | DESCRIPTION |
|---|---|---|---|
| 1 | 201 | 3 | NUT |
| 2 | 305 | 3 | LEG |
| | 205(a) | | CONTAINER |
| | 206(a) | | PLATE |
| | 207(a) | | PLATE |
| 3 | 301 | | PLATE |

(a) ITEM NOT ILLUSTRATED.

J2-5-2-76

Figure 1-25. Check Tool T-5033143




| INDEX NO. | DETAIL NO | QTY | DESCRIPTION |
|---|---|---|---|
| 1 | 103 | 3 | LOCK (LONG) |
| 2 | 104 | 3 | PUSH ROD |
| 3 | 102 | | BASE |
| 4 | 101 | | PLATE |
| 5 | 110 | | BOLT |
| | 111(a) | | CONTAINER |
| | 112(a) | | PLATE |
| 6 | 108 | 3 | WINGNUT |
| 7 | 107 | 3 | WASHER |
| 8 | 105 | 3 | STUD |
| 9 | 106 | 3 | LOCK (SHORT) |

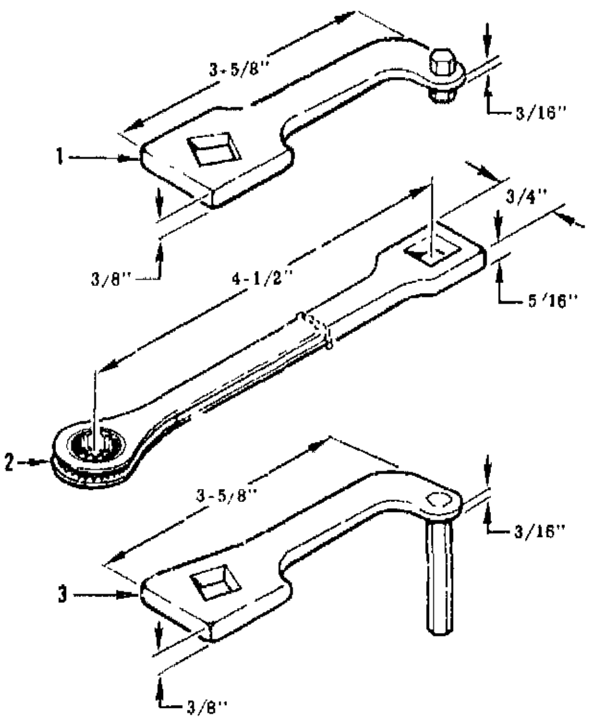
(a) ITEM NOT ILLUSTRATED.

J2-5-2-77

Figure 1-26. Wheel Puller T-5035008

## 1-57A. TORQUE WRENCH ADAPTER T-5038118.

1-57B. The torque wrench adapter (figure 1-26A) is used when replacing the gas generator control valve. Instructions for the use of the adapter are in R-3825-3.




| Index No. | Detail No. | Description |
|---|---|---|
| 1 | 201 | Braze Assembly[a] |
| 2 | 105 | Weld Assembly[b] |
| 3 | 202 | Braze Assembly[c] |
| | 102[d] | Container |
| | 109[d] | Plate |

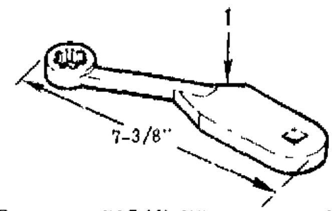
(a) Consists of details 203 and 204 brazed or welded.
(b) Consists of details 103 and 10: welded.
(c) Consists of details 204 and 205 brazed or welded.
(d) Item not illustrated.

J2-5-2-107

Figure 1-26A. Torque Wrench Adapter T-5038118

## 1-58. TORQUE WRENCH ADAPTER T-5038463.

1-59. The torque wrench adapter (figure 1-27) is used to torque the bolts that secure the start tank discharge valve to the start tank. Corrosion must be cleaned from the torque wrench as required (refer to R-3825-5, Volume I). Instructions for the use of the torque wrench are in R-3825-3.




| INDEX NO. | DETAIL NO. | DESCRIPTION |
|---|---|---|
| 1 | NONE | TORQUE WRENCH ADAPTER[b] |
| | 103[a] | PLATE |
| | 101[a] | CONTAINER |

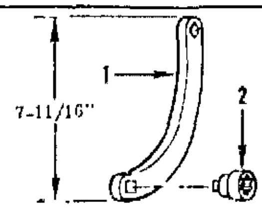
(a) ITEM NOT ILLUSTRATED
(b) CONSISTS OF DETAILS 101 AND 102 WELDED.

J2-5-2-78

Figure 1-27. Torque Wrench Adapter T-5038463

## 1-60. TORQUE WRENCH ADAPTER T-5040045.

1-61. The torque wrench adapter (figure 1-28) is used to torque the bolts that secure the fuel inlet duct to the fuel turbopump. Corrosion must be cleaned from the torque wrench as required (refer to R-3825-5, Volume I). Instructions for the use of the torque wrench are in R-3825-3.




| INDEX NO | DETAIL NO. | DESCRIPTION |
|---|---|---|
| 1 | 101 | HANDLE |
| 2 | NONE | SOCKET[b] |
| | 101[a] | PLATE |
| | 105[a] | CONTAINER |

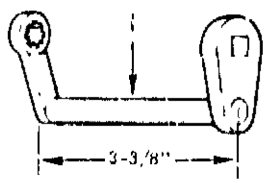
(a) ITEM NOT ILLUSTRATED.
(b) CONSISTS OF DETAILS 102 AND 103.

J2-5-2-79

Figure 1-28. Torque Wrench Adapter T-5040045

## 1-62. TORQUE WRENCH ADAPTER T-5041554.

1-63. The torque wrench adapter (figure 1-29) is used to torque the bolts that secure the augmented spark igniter valve to the main oxidizer valve. Instructions for the use of the torque wrench are in R-3825-3.




| INDEX NO | DETAIL NO. | DESCRIPTION |
|---|---|---|
| 1 | 101 | TORQUE WRENCH ADAPTER |
| | 105[a] | CONTAINER |
| | 106[a] | PLATE |

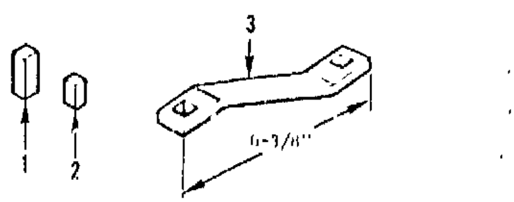
(a) ITEM NOT ILLUSTRATED.

J2-5-2-80

Figure 1-29. Torque Wrench Adapter T-5041554

## 1-64. TORQUE WRENCH T-5044412.

1-65. The torque wrench (figure 1-30) is used to torque the bolts that secure the main oxidizer valve to the oxidizer injector dome. Instructions for the use of the torque wrench are in R-3825-3.




| INDEX NO | DETAIL NO | DESCRIPTION |
|---|---|---|
| 1 | 105 | ADAPTER (1-1/2 IN.) |
| 2 | 102 | ADAPTER (3/4 IN.) |
| | 101[a] | CONTAINER |
| | 101[a] | PLATE |
| 3 | 101 | HANDLE |

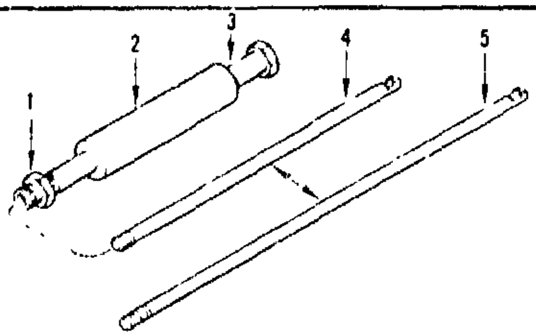
(a) ITEM NOT ILLUSTRATED.

J2-5-2-81

Figure 1-30. Torque Wrench T-5044412

1-66. PIN PULLER T-5044445.

1-67. The pin puller (figure 1-31) is used to pull brass plugs from the leak-detection ports when leak-testing the pneumatic control system. The pin puller engages the head of the brass plug and, used as an impact device, extracts the plug. Minor thread damage can be corrected by chasing threads with a 1/4-28 tap or die. Corrosion must be cleaned as required (refer to R-3825-5, Volume I). Instructions for the use of the pin puller are in R-3825-1B.




| INDEX NO | DETAIL NO | DESCRIPTION |
|---|---|---|
| 1 | 101 | NUT |
| 2 | 102 | TUBING |
| 3 | 103 | BOLT |
| 4 | 104 | EXTENSION (7-1/2 IN.) |
| 5 | 105 | EXTENSION (12-1/8 IN.) |
| | 106[(a)] | PLATE |
| | NONE[(a)] | CONTAINER |

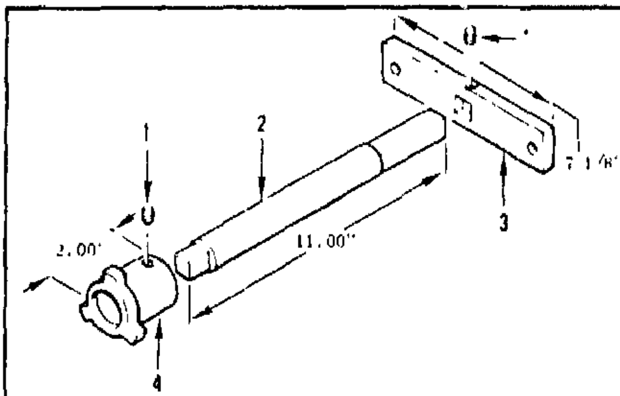
(a) ITEM NOT ILLUSTRATED

12-5-2-82

Figure 1-31. Pin Puller T-5044445

1-68. WRENCH T-5044537.

1-69. The wrench (figure 1-32) is used to prevent rotation of the oxidizer turbopump when installing the inducer bolt or shaft bearing nut. The wrench is bolted to studs on the accessory drive adapter pad and engages the second-stage turbine wheel stud nuts preventing turbopump shaft rotation. Instructions for the use of the wrench are in R-3825-3.




| INDEX NO | DETAIL NO. | QTY | DESCRIPTION |
|---|---|---|---|
| 1 | 101 | 2 | SOCKET SET SCREW |
| | 105[(a)] | | CONTAINER |
| | 108[(a)] | | PLATE |
| 2 | 102 | | BAR |
| 3 | 101 | | RETAINER |
| 1 | 103 | | WRENCH |

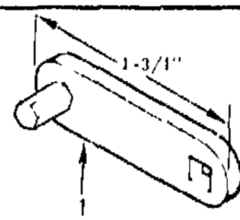
(a) ITEM NOT ILLUSTRATED.

12-5-2-83

Figure 1-32. Wrench T-5044537

1-70. TORQUE WRENCH ADAPTER T-5044632.

1-71. The torque wrench adapter (figure 1-33) is used to torque the bolts that secure the anti-flood check valve to the heat exchanger. Instructions for the use of the torque wrench adapter are in R-3825-3.




| INDEX NO. | DETAIL NO. | DESCRIPTION |
|---|---|---|
| 1 | NONE | TORQUE WRENCH ADAPTER[(b)] |
| | 103[(a)] | PLATE |
| | 101[(a)] | CONTAINER |

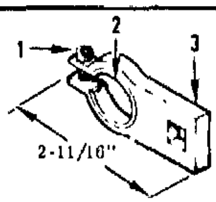
(a) ITEM NOT ILLUSTRATED
(b) CONSISTS OF DETAILS 101 AND 102.

12-5-2-84

Figure 1-33. Torque Wrench Adapter T-5044632

## 1-72. TORQUE WRENCH ADAPTER T-5044633.

1-73. The torque wrench adapter (figure 1-34) is used when connecting or disconnecting flight instrumentation package transducers electrical connector. The adapter is clamped on the electrical connector and is used as a lever to disconnect the connector or a torque wrench adapter when connecting the connector. Minor thread damage can be corrected by chasing threads with a 6-32 tap or die. Damaged rubber can be replaced or debonded rubber can be recemented. The same procedures for repairing STDV swing gate test plate gasket (paragraph 1-10) can be used for cementing debonded or replaced rubber. Instructions for the use of the torque wrench adapter are in R-3825-3.




| INDEX NO. | DETAIL NO. | DESCRIPTION |
|---|---|---|
| 1 | 106 | CAP SCREW |
| 2 | 105 | RUBBER |
| 3 | 101 | WRENCH |
| | 103(a) | PLATE |
| | 104(a) | CONTAINER |

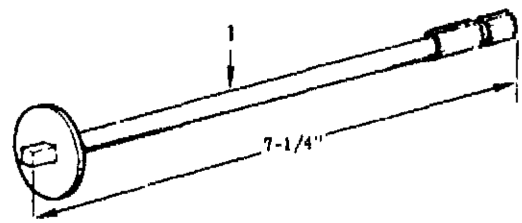
(a) ITEM NOT ILLUSTRATED.

J2-5-2-65

Figure 1-34. Torque Wrench Adapter T-5044633

## 1-74. SPECIAL TOOL (REAMER) T-5047110.

1-75. The special tool (figure 1-35) is used to ream the ignition detector probe bore whenever interference is encountered when installing the ignition detector probe. Instructions for the use of the special tool are in R-3825-3.




| INDEX NO. | DETAIL NO. | DESCRIPTION |
|---|---|---|
| 1 | NONE | REAMER(b) |
| | 102(a) | PLATE |
| | NONE(a) | CONTAINER |

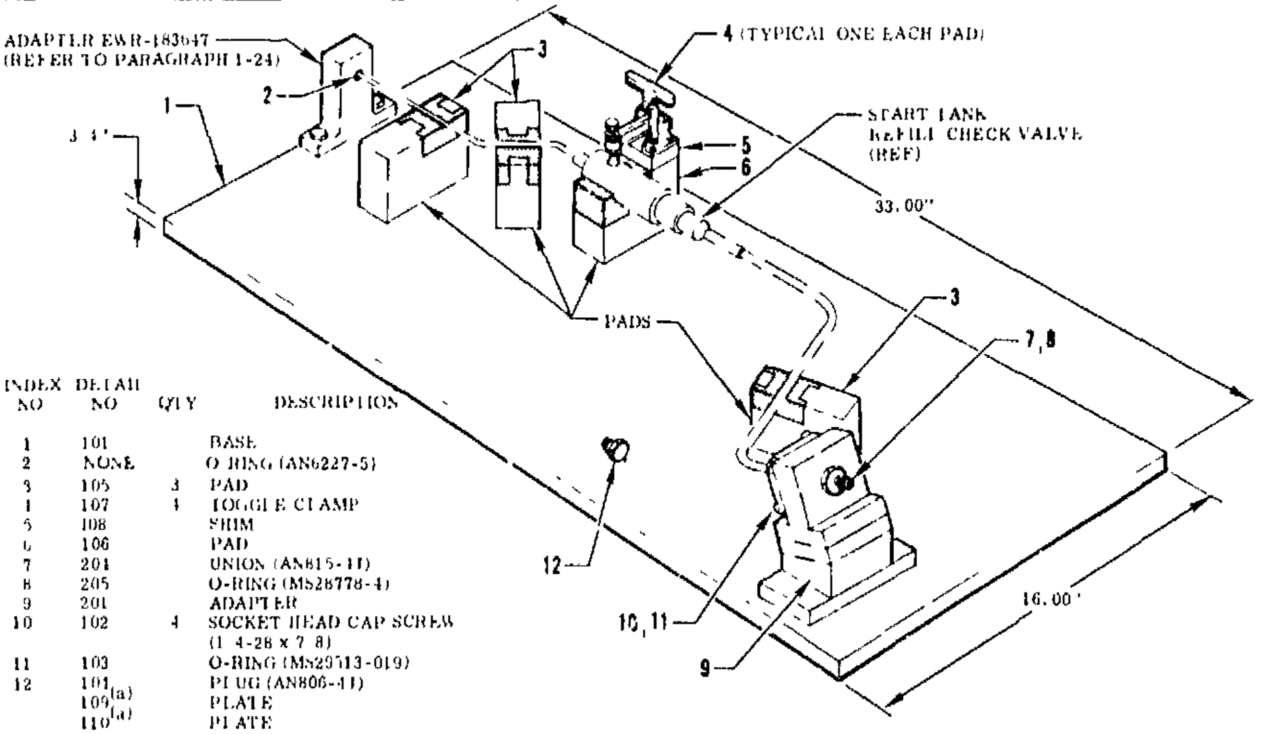
(a) ITEM NOT ILLUSTRATED.
(b) CONSISTS OF DETAILS 101 AND 103.

J2-5-2-86

Figure 1-35. Special Tool (Reamer) T-5047110

## 1-76. PRESSURE TEST FIXTURE T-5047149.

1-77. The pressure test fixture (figure 1-36) is used with adapter EWR-183647 (figure 1-10) to test the start tank refill check valve. The test fixture provides the capability to secure the start tank refill check valve and to apply pressure to the flanged end. Minor thread damage can be corrected by chasing threads with an appropriate size tap. Use a 1/4-28 tap on the flange attach holes and a 7/16-20 UNJF-3B tap on the pressure port. Instructions for the use of the pressure test fixture are in R-3825-3.




| INDEX NO | DETAIL NO | QTY | DESCRIPTION |
|---|---|---|---|
| 1 | 101 | | BASE |
| 2 | NONE | | O RING (AN6227-5) |
| 3 | 105 | 3 | PAD |
| 4 | 107 | 4 | TOGGLE CLAMP |
| 5 | 108 | | SHIM |
| 6 | 106 | | PAD |
| 7 | 204 | | UNION (AN815-4D) |
| 8 | 205 | | O-RING (MS28778-4) |
| 9 | 201 | | ADAPTER |
| 10 | 102 | 4 | SOCKET HEAD CAP SCREW (1 4-28 x 7 8) |
| 11 | 103 | | O-RING (MS29513-019) |
| 12 | 104 | | PLUG (AN806-4D) |
| | 109[a] | | PLATE |
| | 110[a] | | PLATE |

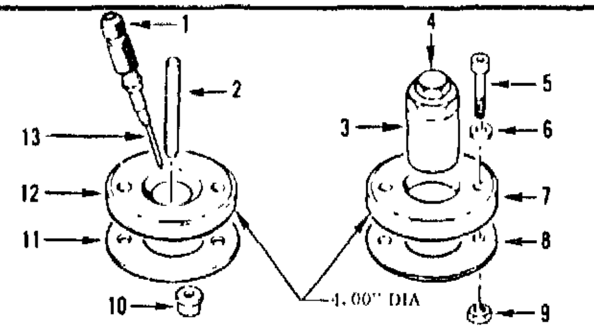
(a) ITEM NOT ILLUSTRATED.

J2-5-2-98

Figure 1-36. Pressure Test Fixture T-5047149

1-78. STAKING TOOL T-5047359.

1-79. The staking tool (figure 1-37) is used to remove and/or stake the heat exchanger filter retaining stud. A flange protector is installed on the heat exchanger inlet flange and the automatic center punch used to stake the stud, or the stud remover, and the housing, used to remove the stud. Flange protector (102) is used when staking; and flange protector (105) is used when removing the stud. When staking the thread protector is used to protect the stud threads from damage. Blank plates plug the heat exchanger coils during use of the staking tool to protect the coils from contamination. Minor thread damage (socket head cap screw and plugs) can be corrected by chasing threads with a 1/4-20 tap or die. Damaged gaskets can be replaced or debonded Teflon gasket can be recemented (refer to cementing Teflon gaskets in section XXXIII). Instructions for the use of the staking tool are in R-3825-3.




| INDEX NO | DETAIL NO. | QTY | DESCRIPTION |
|---|---|---|---|
| 1 | 101 | | AUTOMATIC CENTER PUNCH |
| 2 | 103 | | THREAD PROTECTOR |
| 3 | 113 | | HOUSING |
| 4 | 104 | | STUD REMOVER |
| 5 | 110 | 2 | SOCKET HEAD CAP SCREW (5/16-18 x 1-1/4 IN.) |
| 6 | 111 | 2 | WASHER (RD153-5002-0005) |
| 7 | 105 | | FLANGE PROTECTOR |
| | 106[a] | | PLATE |
| 8 | 108 | | TEFLON GASKET |
| 9 | 112 | 2 | NUT (5 16-18) |
| 10 | 114 | 4 | PLUG |
| | NONE[a] | | CONTAINER |
| 11 | 109 | | TEFLON GASKET |
| 12 | 102 | | FLANGE PROTECTOR |
| 13 | 107 | | TIP |

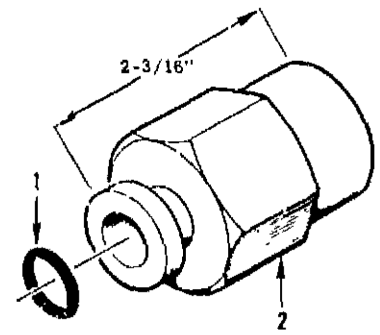
(a) ITEM NOT ILLUSTRATED.

J2-5-2-87

Figure 1-37. Staking Tool T-5047359

1-79A. PRESSURE TEST FIXTURE T-5047377.

1-79B. The pressure test fixture (figure 1-37A) is used to leak test air filler valves. The air filler valve is screwed fingertight into the test fixture and the fixture hose connected to the leak-detector. Minor thread damage can be corrected by chasing threads with 1/2-20 NF tap. Polishing is permitted to remove scratches and minor damage from sealing surfaces. Instructions for the use of the pressure test fixture are in R-3825-3.




| Index No. | Detail No. | Description |
|---|---|---|
| 1 | 102 | O-ring MS29513-111 |
| 2 | 101 | 321 CRES (1-1/4 inch HEX x 2-3/16 inch long) |
| | 103(a) | Plate |

(a) Item not illustrated.

J2-5-2-106

Figure 1-37A. Pressure Test Fixture T-5047377

## 1-80. SPARK IGNITER CABLE TOOLS XEO R914129 (D1 THROUGH D5).

1-81. The spark igniter cable tools (figure 1-38) are used to repair spark igniter cables 651389 and 651390. The tools provide the capability of removing, installing, and checking the installation of the retaining ring, and trimming the grommet sleeve. Instructions for the use of the spark igniter cable tools are in R-3825-3.

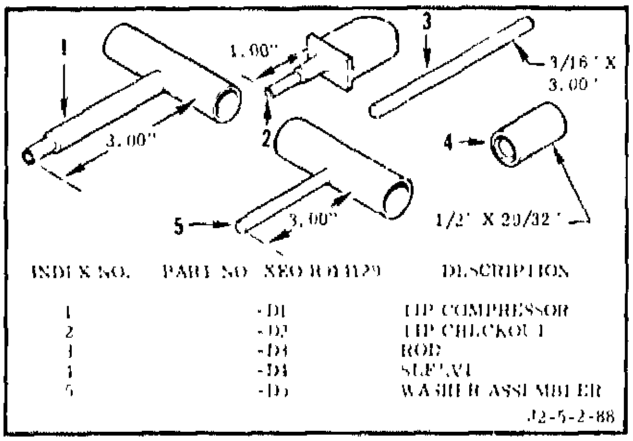



Figure 1-38. Spark Igniter Cable Tools XEO R914129 (D1 Through D5)

## 1-82. ENGINE LOWERING FIXTURE (PROOF LOAD WEIGHT SLING) XEO R923020.

1-83. The engine lowering fixture (figure 1-39) is used to proof-test the engine lowering systems contained in Engine Components Installers G4071 and G4072. The lowering systems are attached to the fixture which duplicates the stage attach points used by the lowering systems. Corrosion must be cleaned as required from the lowering fixture (refer to R-3825-5, Volume I). Instructions for the use of the lowering fixture are in section XXXIII.

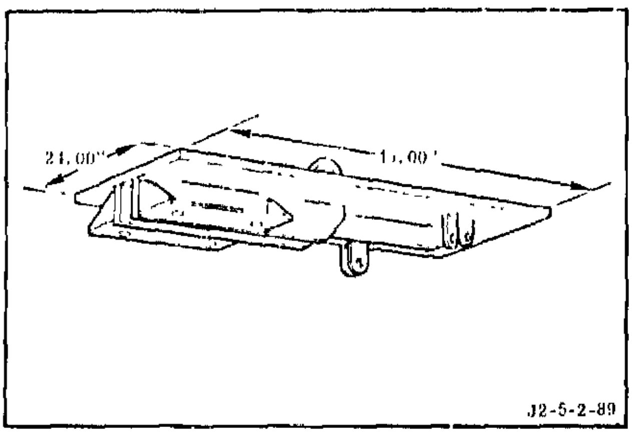



Figure 1-39. Engine Lowering Fixture XEO R923020

## 1-84. POTENTIOMETER TEST CABLE XEO R938830.

1-85. The potentiometer test cable (figure 1-40) is used when adjusting the mixture ratio control valve position indicator. The test cable is connected to the position indicator and is used to apply voltages to and measure voltages from the position indicator. Instructions for the use of the test cable are in R-3825-3.

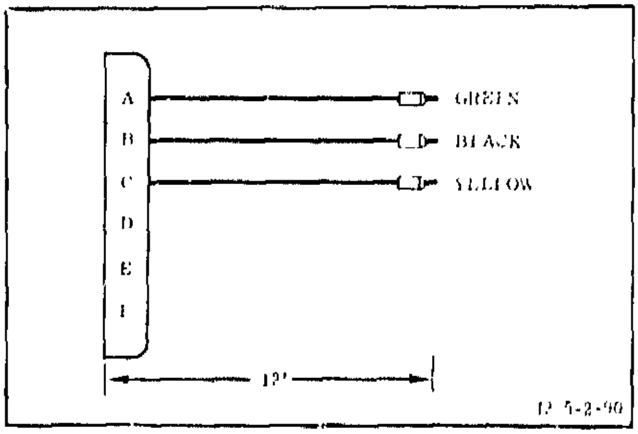
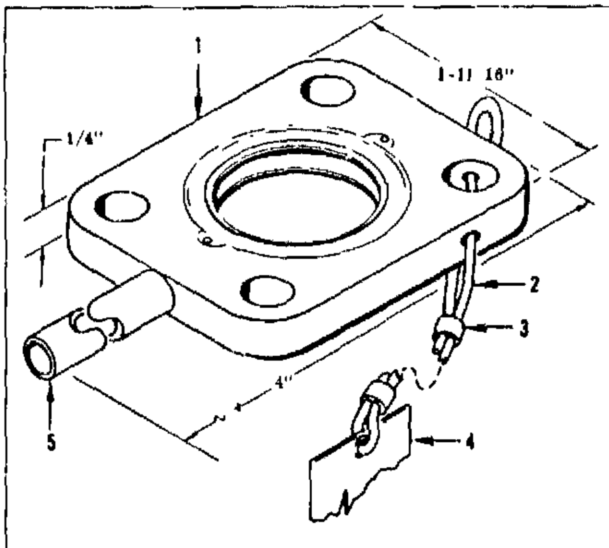



Figure 1-40. Potentiometer Test Cable XEO R938830

## 1-85A. ADAPTER XEO R939108.

1-85B. The adapter (figure 1-40A) is used to introduce a purge into the MRCV control line when welding is required on the control line. Damage to the Teflon dispersion coat is not cause for rejection of the adapter unless the damage extends into the base metal. Field repair is limited to replacement of damaged streamer or streamer attaching parts. Instructions for the use of the adapter are in R-3825-3, Volume I.




| INDEX NO. | PART NO | QTY | DESCRIPTION |
|---|---|---|---|
| 1 | XEO R039138-7 | 1 | SEAL (BONDED TO INDEX NO. 5) |
| 2 | RD191-2001-1108 | 1 | WIRE ROPE - (CABLE) |
| 3 | 28-1-C | 2 | SLEEVE |
| 4 | RD170-6006-0001 | 1 | STREAMER - NYLON |
| 5 | XEO R039108-3 | 1 | TUBE (BONDED TO INDEX NO. 1) |

J2-5-2-109

Figure 1-40A. Adapter XEO R939108

## 1-86. COMPARISON SLEEVES 046911.

1-87. The comparison sleeves (figure 1-41) are used to evaluate the cleaning procedure used on weld sleeves. The weld sleeve to be used is visually compared to the comparison sleeves for acceptability. Instructions for the use of the comparison sleeves are in R-3825-3.

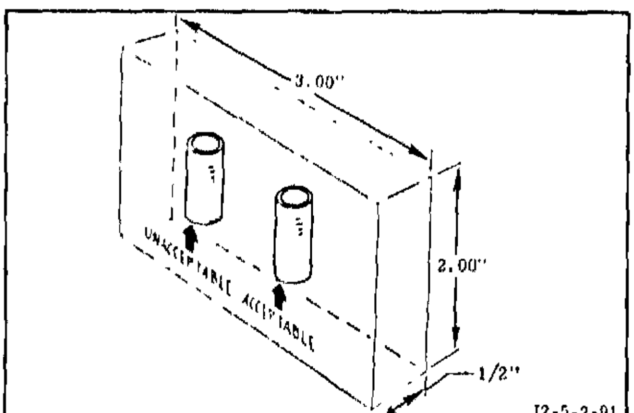



Figure 1-41. Comparison Sleeves 046911

1-88. FILTER TOOL 557217-11.

1-89. The filter tool 557217-11 (figure 1-42) is used to retain K-seals when installing the helium tank emergency vent control valve and/or the helium control valve. The K-seals are held in place by securing the filter tool over the seals. The component containing the K-seals is then attached to its mating component, and the filter tool is removed before the final torque is applied. Tape on filter tool must be replaced whenever tape is damaged or shows evidence of the tool being used. P421 Teflon tape (Johnson and Johnson, Inc), or equivalent is to be used. Instructions for the use of the filter tool are in R-3825-3.

1-90. FILTER TOOL 558674-11.

1-91. The filter tool 558674-11 (figure 1-42) is used to retain K-seals when installing the helium control valve filter. The K-seals are held in place by securing the filter tool over the seals. The helium control valve filter is attached to the helium regulator and the filter tool is removed before the final torque is applied. Tape on filter tool must be replaced whenever tape is damaged or shows evidence of the tool being used. P421 Teflon tape (Johnson and Johnson, Inc), or equivalent is to be used. Instructions for the use of the filter tool are in R-3825-3.

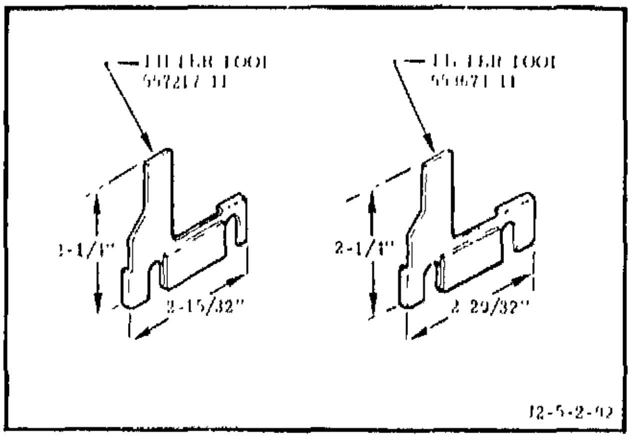



Figure 1-42. Filter Tool 557217-11 and 558674-11

1-92. FIRST-STAGE TURBINE WHEEL GAGE 88-460088.

1-93. The first-stage turbine wheel gage (figure 1-43) is used to verify the correct installation of the fuel turbine first-stage turbine wheel. The gage is bolted to the turbine manifold and the slide moved to the limit of its travel. The amount of slide travel indicates the correct or incorrect installation of the turbine wheel. Minor thread damage can be corrected by chasing threads with a 1/4-28 NF-3B tap. Instructions for the use of the turbine wheel gage are in R-3825-3.

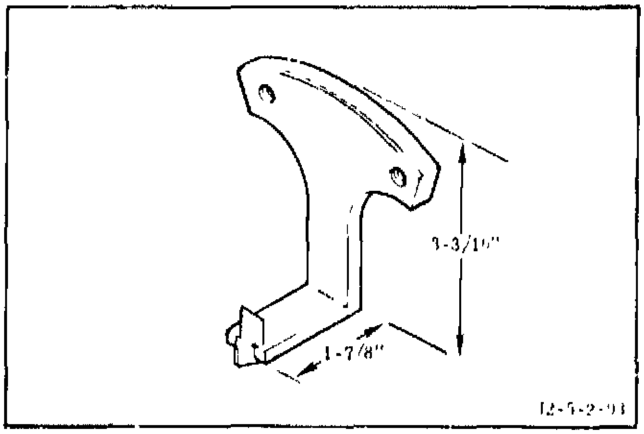
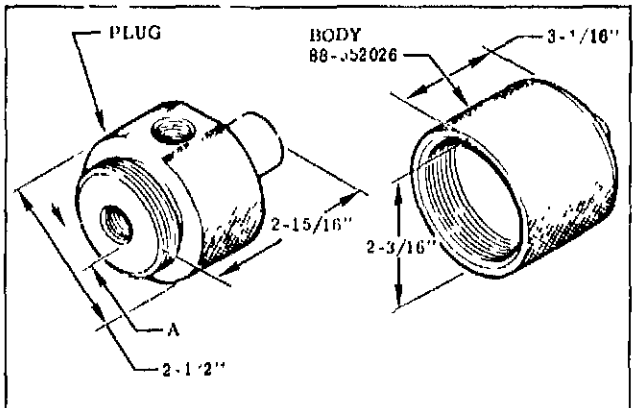



Figure 1-43. First-Stage Turbine Wheel Gage 88-460088

1-94. VENT PORT CHECK VALVES TEST FIXTURE BODY 88-552026 AND PLUGS 88-552028, 88-552029, AND 88-552031. (See figure 1-44.)

1-95. The vent port check valve test fixture body and plug when assembled form a leak-tight fixture, encasing the check valve to be tested. Leakage and cracking pressure of the check valve is then checked by applying pneumatic pressure to one end of the fixture and observing pneumatic flow from the other. Minor thread damage can be corrected by chasing threads. Polishing is permitted to remove

scratches and minor damage from sealing surfaces. Damaged anodized coating can be repaired (refer to repairing chemical film in R-3825-5, Volume I). Instructions for the use of the vent port check valve test fixtures are in R-3825-3.




| Plug | Dimension - A |
|---|---|
| 88-552028 | For 1/4" Tube |
| 88-552029 | For 1/2" Tube |
| 88-552031 | For 3/4" Tube |

Figure 1-44. Vent Port Check Valve Test Fixture Body 88-552026 and Plugs 88-552028, 88-552029, and 88-552031

1-96. ENGINE SOLENOID CONTROL BOX 99-9019901.

1-97. The engine solenoid control box (figure 1-45) is used for local control of engine solenoid valves when such control cannot be obtained from the stage. The control box is connected to a source of 28 vdc and to the solenoid valves to be controlled. Operation of related switches on the control box energizes or deenergizes the solenoids. Defective components may be replaced. The electrical schematic is shown in figure 1-45. Instructions for the use of the engine solenoid control box are in R-3825-1B.

1-98. VALVE RESISTANCE TEST SELECTOR BOX 99-9019902.

1-99. The valve resistance test selector box (figure 1-46) is used when testing the electrical resistance of the engine solenoid control valves. The control valve to be tested is connected to the selector box with the appropriate cable supplied with the control box. Coil and insulation resistance of the valve is found by connecting test instruments to the appropriate test jacks. Defective components may be replaced. The electrical schematic is shown in figure 1-46. Instructions for the use of the valve resistance test selector box are in R-3825-1B.

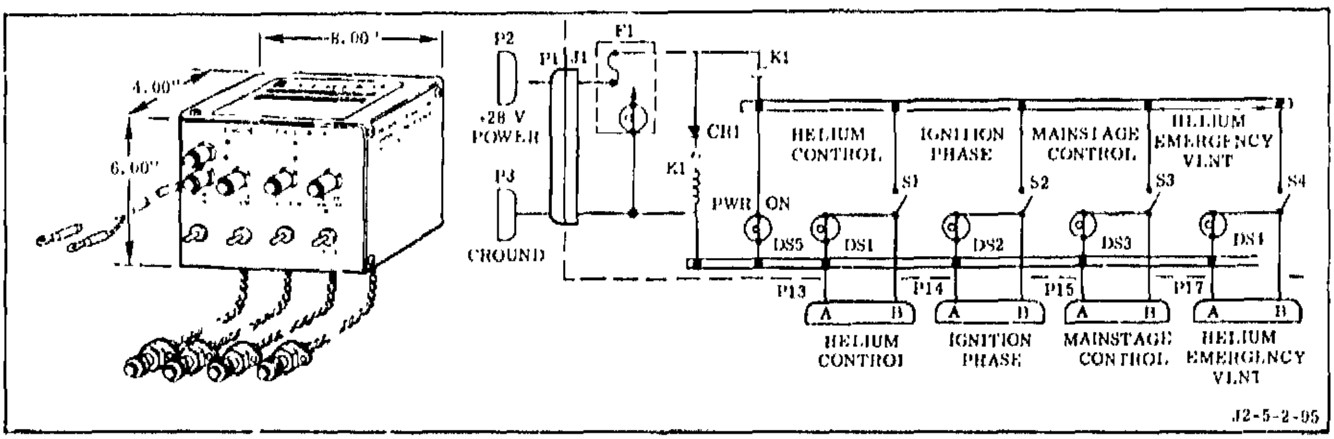
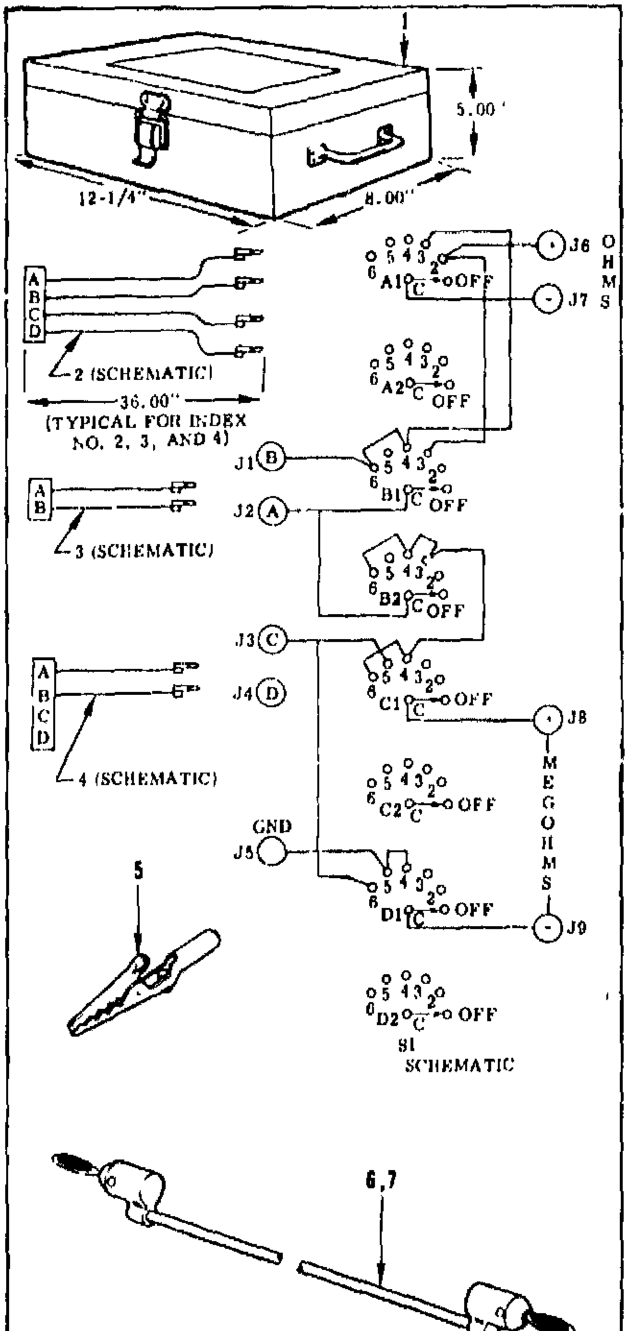



Figure 1-45. Engine Solenoid Control Box 99-9019901




| INDEX NO. | PART NO. | QTY | DESCRIPTION |
|---|---|---|---|
| 1 | NONE | | CONTAINER |
| 2 | 9019946 | | TEST CABLE |
| 3 | 9019946-11 | | TEST CABLE |
| 4 | 9019946-21 | | TEST CABLE |
| 5 | 60-CS[b] | | CLIP |
| 6 | MODEL B-12[a] | 4 | TEST LEAD (2 GREEN, 1 EACH RED AND BLACK, 12-IN. LONG) |
| 7 | MODEL B-72[a] | | TEST LEAD (BLACK, 72-IN. LONG) |

(a) POMONA ELECTRONICS CO. INC.
(b) MUELLER ELECTRIC CO.

J2-5-2-96

**Figure 1-46. Valve Resistance Test Selector Box 99-9019902**

# SECTION II

# GAS GENERATOR HIGH-LOW TEMPERATURE CUTOFF PANEL G1047

## WARNING

GAS GENERATOR HIGH-LOW TEMPERATURE CUTOFF PANEL G1047 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

## TABLE OF CONTENTS



### 2-1. DESCRIPTION, LEADING PARTICULARS, AND CONFIGURATION CHANGES FOR GAS GENERATOR HIGH-LOW TEMPERATURE CUTOFF PANEL.

### 2-2. DESCRIPTION.

2-3. The gas generator high-low temperature cutoff panel (figure 2-1) is a rack-mounted electronic instrumentation panel, having two indicator lights, three switches, and a sealable access cover on its front side. The panel monitors the gas generator exhaust gas temperature during an engine hot-fire test and provides an engine test cutoff signal in the event the monitored temperature fails to reach, exceeds, or falls below, preset limits. Panel circuitry operation is activated by a mainstage signal initiated by engine circuitry and remains in operation throughout engine mainstage operation. When the mainstage signal is received, the panel starts two delay timers. The panel will initiate an engine test cutoff signal under the following conditions: (1) upon expiration of the 0.05 to 1.0 second timer if the monitored temperature has failed to reach a preset low-temperature (150° to 400° F) limit; (2) anytime, after the expiration of the 0.05 to 1.0 second

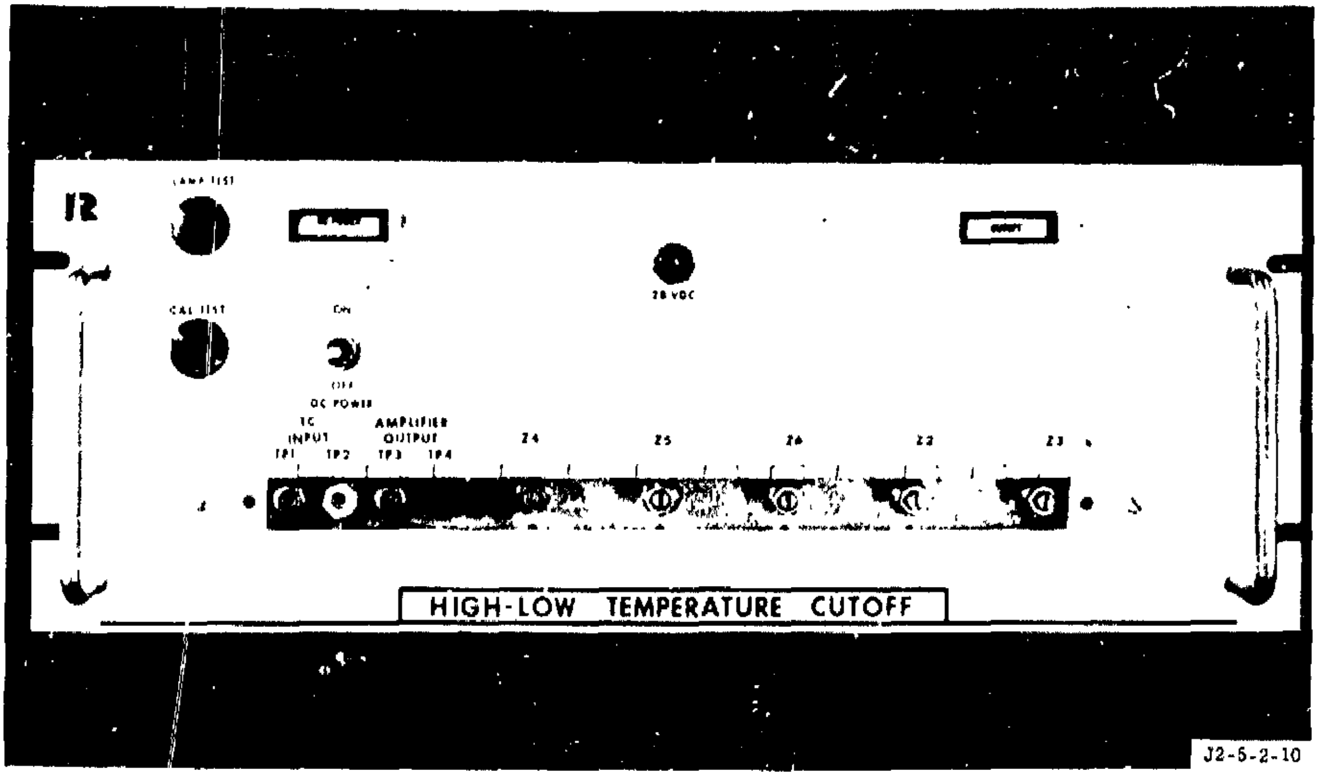



Figure 2-1. Gas Generator High-Low Temperature Cutoff Panel

timer and before expiration of the 0.4 to 8.0 seconds timer, that the monitored temperature exceeds a preset high-temperature (1,700° to 2,200° F) limit; and (3) anytime, after the expiration of the 0.4 to 8.0 seconds timer, that the monitored temperature exceeds a preset medium-temperature (1,300° to 1,700° F) limit. Lock-in circuits in the high-temperature and medium-temperature limit switches maintain the cutoff condition until they are reset. Instructions for the use of the gas generator high-low temperature cutoff panel are in R-3825-1B.

## 2-4. LEADING PARTICULARS.

2-5. Mounted on the front face of the panel are a circuit breaker, a power switch, two indicator lamps (DC POWER ON and CUTOFF), a lamp test switch, and a scalable access cover. Under the scalable access cover are a test s itch and five calibration adjustments (potentiometers). Mounted on the rear of the panel is a chassis containing an amplifier, two timers, three temperature limit switches, two relays, and terminal boards. On the rear of the chassis are two electrical receptacles. See figure 2-2 for additional leading particulars.

| | |
|---|---|
| Dimensions | |
| Height | 7 inches |
| Width | 19 inches |
| Depth | 16 inches |
| Weight | 20 pounds (approximate) |
| Power requirements | 28 ±2 vdc |
| Temperature limit switch adjustment ranges | |
| | 150° to 400° F<br>1,300° to 1,700° F<br>1,700° to 2,200° F |
| Timer adjustment ranges | |
| | 0.05 to 1.0 sec<br>0.4 to 8.0 sec |

Figure 2-2. Leading Particulars--Gas Generator High-Low Temperature Cutoff Panel

| Approved ECP No. | MD No. | Incorporated in Manual Dated |
|---|---|---|
| J2-534 | MD1 | 29 July 1966 |
| J2-534 | MD4 | 19 January 1967 |
| J2-535 | MD2 | 22 February 1967 |
| J2-533 | MD3 | 1 May 1967 |

Figure 2-3. Configuration Changes--Gas Generator High-Low Temperature Cutoff Panel

2-6. CONFIGURATION CHANGES--MANUAL EFFECTIVITY.

2-7. Modifications incorporated in this manual that change the configuration of the gas generator high-low temperature cutoff panel are listed in figure 2-3. All panels have MD1, MD2, and MD3 changes incorporated. On panels incorporating MD4 change, potentiometer R11 is permanently connected across the thermocouple input circuit. This change provides safety circuit protection prior to expiration of the 0.4 to 8.0 seconds timer.

2-8. THEORY OF OPERATION OF GAS GENERATOR HIGH-LOW TEMPERATURE CUTOFF PANEL.

2-9. THEORY OF PANEL OPERATION.

2-10. The gas generator high-low temperature cutoff panel monitors the temperature sensed by the gas generator thermocouple throughout an engine test. (See figure 2-4 for panel circuit schematic.) The chromel-alumel thermocouple signal is sensed and proportionately amplified by amplifier Z1, and then distributed to each of the temperature limit switches Z4, Z5, and Z6. Amplifier Z1 also provides an auxiliary output to a facility temperature monitor recorder. Upon receiving a mainstage signal (28 vdc, positive) from engine circuitry, timers Z2 and Z3 begin their time delay functions. Upon expiration of its delay time (adjustable from 0.05 to 1.00 second), timer Z2 relays the mainstage signal to temperature limit switches Z4 and Z6. Upon expiration of its delay time (adjustable from 0.4 to 8.0 second), timer Z3 relays the mainstage signal to temperature limit switch Z5 and to safety circuit relay K3. If, after the expiration of timer Z2, the amplifier output voltage (gas generator temperature) has failed to reach the calibration setting of low-temperature limit switch Z4, the switch (Z4) will transmit a voltage to cutoff relay K2, initiating engine cutoff. If, after the expiration of timer Z2, the amplifier voltage (gas generator temperature) reaches or exceeds the calibration setting of high-temperature limit switch Z6, the switch (Z6) will transmit a voltage to cutoff relay K2 to initiate engine cutoff. If, after the expiration of timer Z3, the amplifier voltage (gas generator temperature) reaches or exceeds the calibration setting of medium temperature limit switch Z5, the switch (Z5) will transmit a voltage to cutoff relay K2 to initiate engine cutoff. Because temperature limit switches Z5 and Z6 incorporate hold-in circuits to prevent cutoff relay K2 from dropping out, remote reset relay K1 is provided to temporarily interrupt the mainstage signal and power supplied to the limit switches, thereby dropping relay K2 and resetting the switches to a noncutoff condition. Adjustments Z2 (.05 - 1.0) and Z3 (0.4 - 8.0), located under the access cover, are provided to calibrate timers Z2 and Z3, respectively. Adjustments Z4 (200° - 400°, or 150° - 400°), Z5 (1300° - 1700°), and Z6 (1700° - 2200°), also located under the access cover, are provided to calibrate temperature limit switches Z4, Z5, and Z6, respectively. On panels incorporating MD3 change, potentiometer R10 is installed across the amplifier auxiliary output (eliminating the need to install the 15-ohm exterior resistor) to provide an adjustment for the facility temperature monitor recorder and to provide proper amplifier loading. Potentiometer R11 is installed across amplifier Z1 input (thermocouple), providing an input loading safety circuit to prevent amplifier drift in the event of a momentary or intermittent thermocouple open circuit. On panels not incorporating MD4 change, safety circuit relay K3 connects potentiometer R11 across amplifier Z1 input (thermocouple) only after expiration of timer Z3.

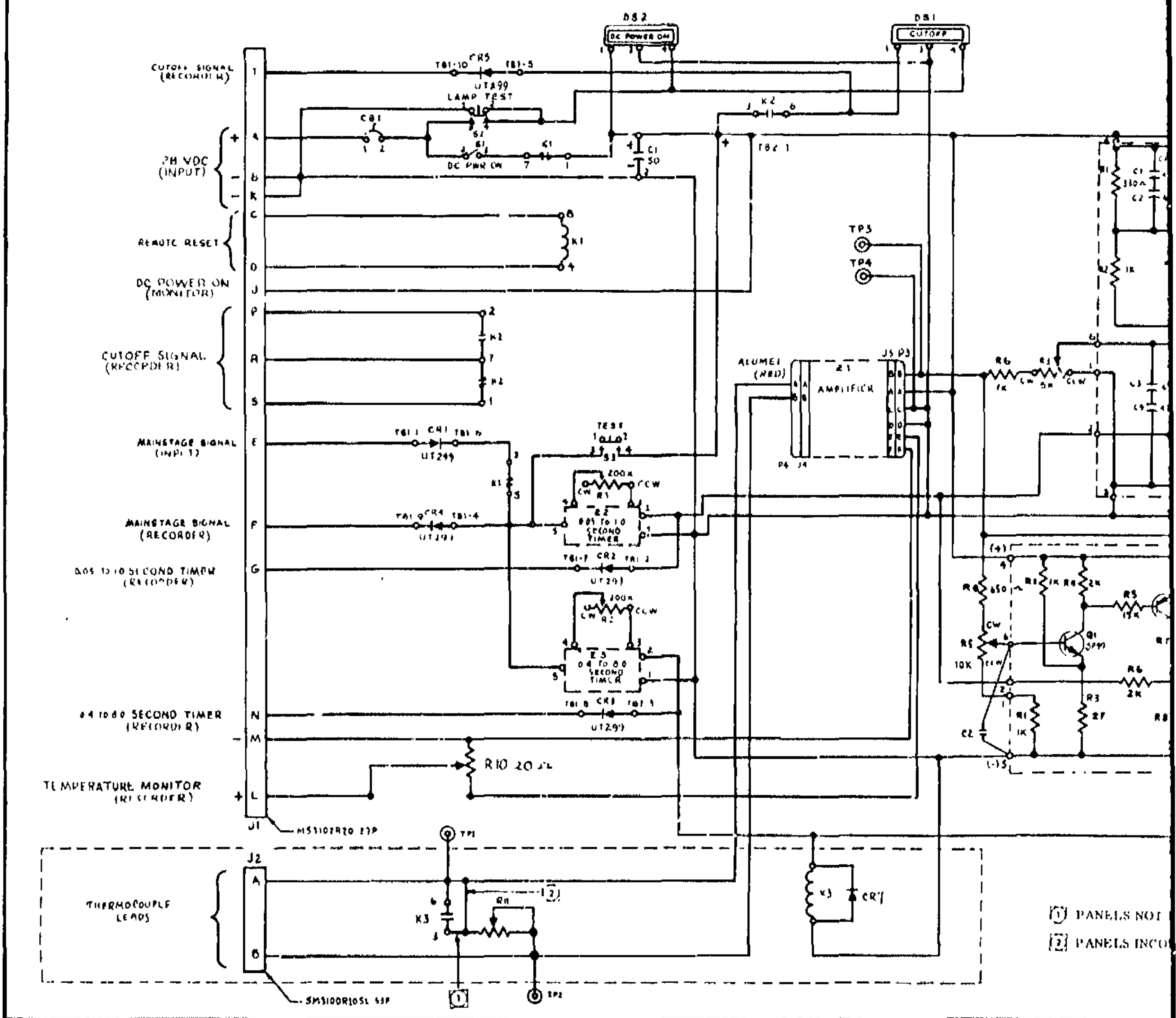
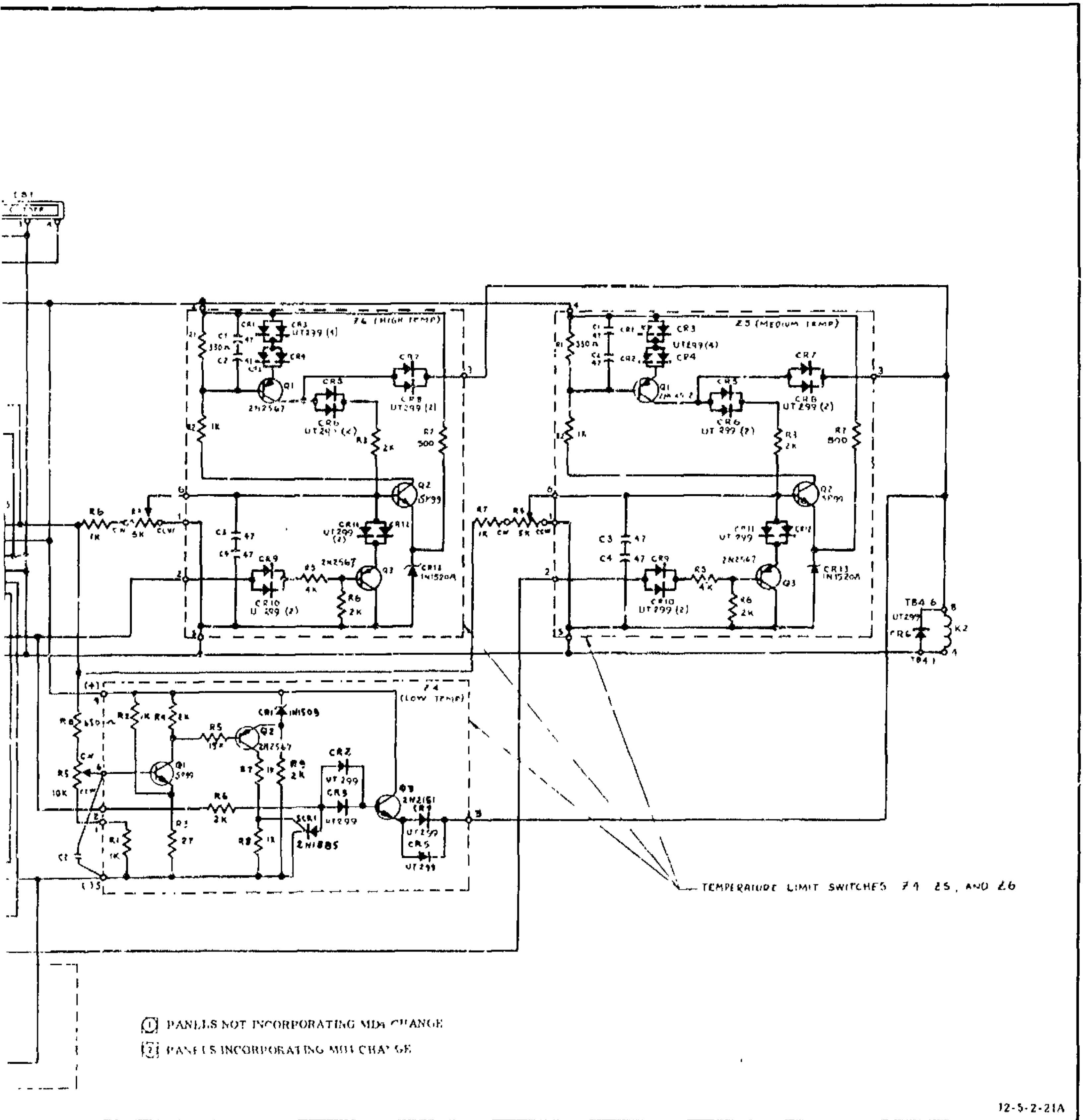


Figure 2-4. Schematic--Gas Generator High-Low Temperature Cutoff Panel




PANELS NOT INCORPORATING MD4 CHANGE

PANELS INCORPORATING MD4 CHANGE

J2-5-2-21A

2-11. THEORY OF COMPONENT OPERATION.

2-12. AMPLIFIER Z1. Amplifier Z1 is a solid-state voltage amplifier. The thermocouple voltage is proportionately amplified in the amplifier with reference to an integral temperature compensating circuit, a ZERO output adjustment, and a GAIN adjustment. (The gas generator exhaust gas temperature thermocouple produces an input voltage to the amplifier relative to the temperature in the gas generator.) Two separate outputs are provided.

2-13. TIMERS Z2 AND Z3. Timer Z2 (adjustable from 0.05 to 1.00 second) and timer Z3 (adjustable from 0.4 to 8.0 seconds) are solid-state time delay relays, adjusted by potentiometer R1 (adjustment Z2 or .05 - 1.0) or potentiometer R2 (adjustment Z3 or 0.4 - 8.0). The timers are activated by the engine mainstage signal.

2-14. LOW-TEMPERATURE LIMIT SWITCH Z4. Low-temperature limit switch Z4 is a solid-state electrical switch. A temperature-related voltage (from amplifier Z1) supplied through potentiometer R5 (adjustment Z4, 200° - 400°, or 150° - 400°) is monitored and produces an internal inhibit signal. Should the temperature-related voltage (from amplifier Z1) be less than required after expiration of timer Z2, the internal inhibit signal stops and the mainstage signal is relayed to actuate the cutoff relay K2.

2-15. MEDIUM-TEMPERATURE AND HIGH-TEMPERATURE LIMIT SWITCHES Z5 AND Z6. Medium-temperature limit switch Z5 and high-temperature limit switch Z6 are identical solid-state electrical switches. The switches monitor the temperature-related voltage (from amplifier Z1) provided by potentiometer R4 (adjustment Z5 or 1300° - 1700°) for limit switch Z5, or by potentiometer R3 (adjustment Z6 or 1700° - 2200°) for limit switch Z6. If, upon timer expiration, the temperature-related control voltage is more than required, the mainstage signal is relayed to provide voltage to cutoff relay K2. A locking feature locks the switch until a temporary loss of power (effected by the remote reset or power switch) resets the switch by interrupting the circuit.

2-16. SAFETY CIRCUIT. A safety circuit is provided to protect against a cutoff initiated by an intermittent or momemtary opening in the amplifier Z1 input (thermocouple) circuit. Upon expiration of timer Z3, safety circuit relay K3 connects amplifier input loading potentiometer R11 across the amplifier input. On panels incorporating MD4 change, potentiometer R11 is connected across the amplifier input at all times.

2-17. <u>MAINTENANCE AND REPAIR OF GAS GENERATOR HIGH-LOW TEMPERATURE CUTOFF PANEL.</u>

2-18. Maintenance requirements for the gas generator high-low temperature cutoff panel are listed in figure 2-5. The figure lists the tasks required, when the tasks are to be performed, and provides paragraph references necessary to accomplish these tasks. Components of the panel are identified in figure 2-6.

2-19. CLEANING. Dirt, dust, and particles of foreign material lodged between electrical terminals can cause a malfunction during an engine test. Clean dirt, dust, and particles from panel with a vacuum cleaner or by carefully using low-pressure gaseous nitrogen or air (10 psig maximum). Refer to R-3825-5, Volume I, for applicable cleaning procedures and safety precautions.

2-20. PAINTING. Paint front face of panel, when required, with semigloss enamel (TT-E-529), color 26440 (Federal Standard 595).

2-21. REPAIRING. No special instructions are required for removing and installing components, except that paint and varnish must be removed from around boltholes to provide an electrical bond between components. Refer to R-3825-5, Volume I, for applicable torque values. See figure 2-6 to identify replaceable components and attaching hardware. See figure 2-7 for wiring information. A complete function test is required after any repair involving an electrical connection.

2-22. INSTALLING. Requirements for installing the gas generator high-low temperature cutoff panel in an instrumentation facility are listed in figure 2-8.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect for loose or broken exterior components and electrical connectors. | X | X | X | | Replace or repair as necessary. (Refer to paragraph 2-21.) |
| Inspect for loose or broken interior components and electrical connections. | X | | | X | Inspect prior to function testing. Replace or repair, as necessary. (Refer to paragraph 2-21.) |
| Inspect exterior surface for: | | | | X | Every 6 months, and prior to function testing. |
| Cleanness | X | | X | | Refer to R-3825-5, Volume I. |
| Scratches | X | | X | | Burnish and paint scratched area. Refer to paragraph 2-20. |
| Paint | X | | X | | Refer to paragraph 2-20. |
| Inspect interior for cleanness. | X | | X | X | Inspect prior to function-testing. (Refer to paragraph 2-19.) |
| Function-test panel. | | | | X | Function-test panel prior to installation, after repair or modification, and whenever a malfunction is suspected. (Refer to paragraph 2-23.) |
| Calibrate panel. | | | | X | Calibrate panel after installation, after function-testing, at 6-month intervals, and whenever thermocouple cable length is changed. (Refer to paragraph 2-26.) |
| Check indicator lamps. | | X | | | Replace as necessary. (Refer to paragraph 2-21.) |

Figure 2-5. Maintenance Requirements--Gas Generator High-Low Temperature Cutoff Panel

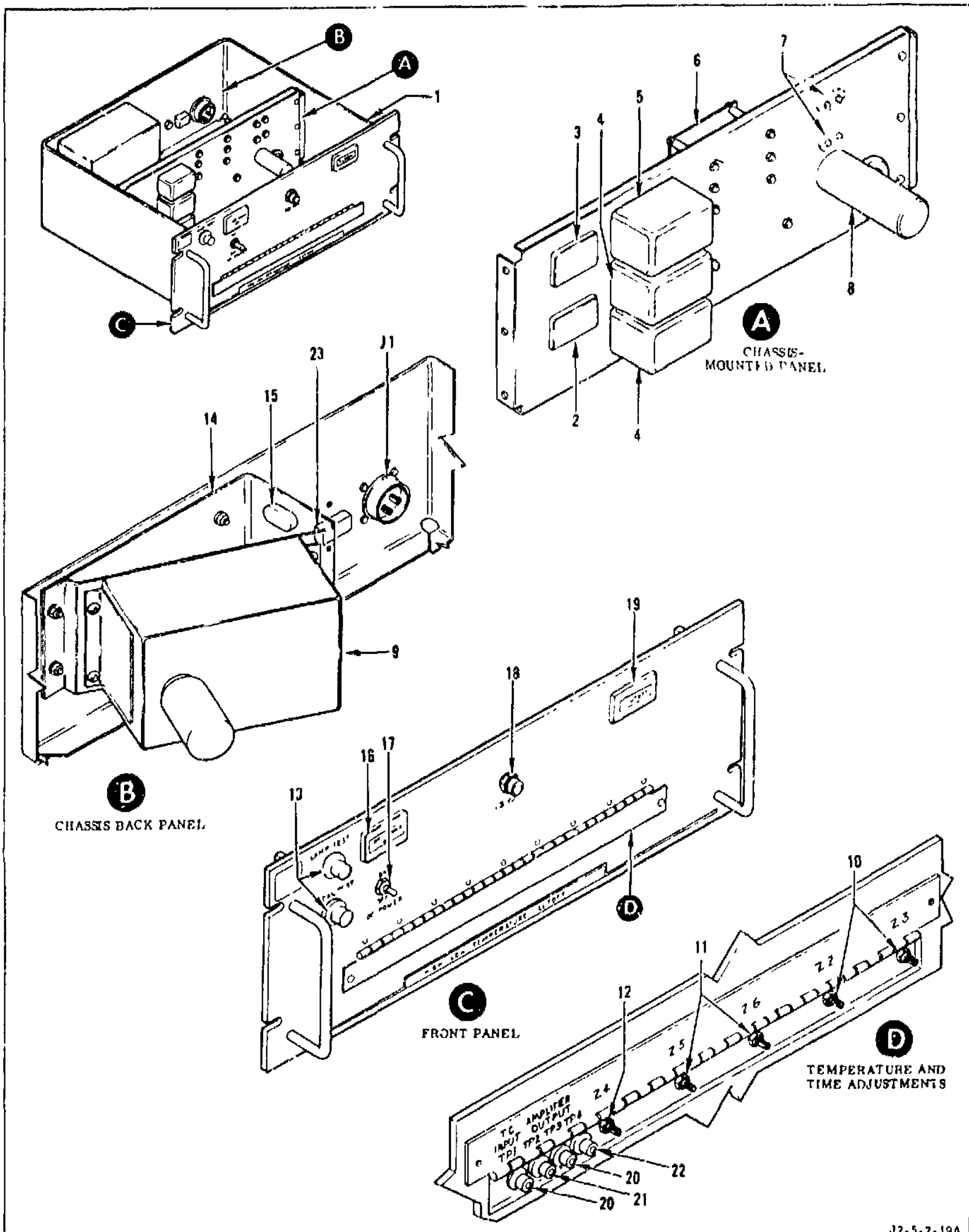
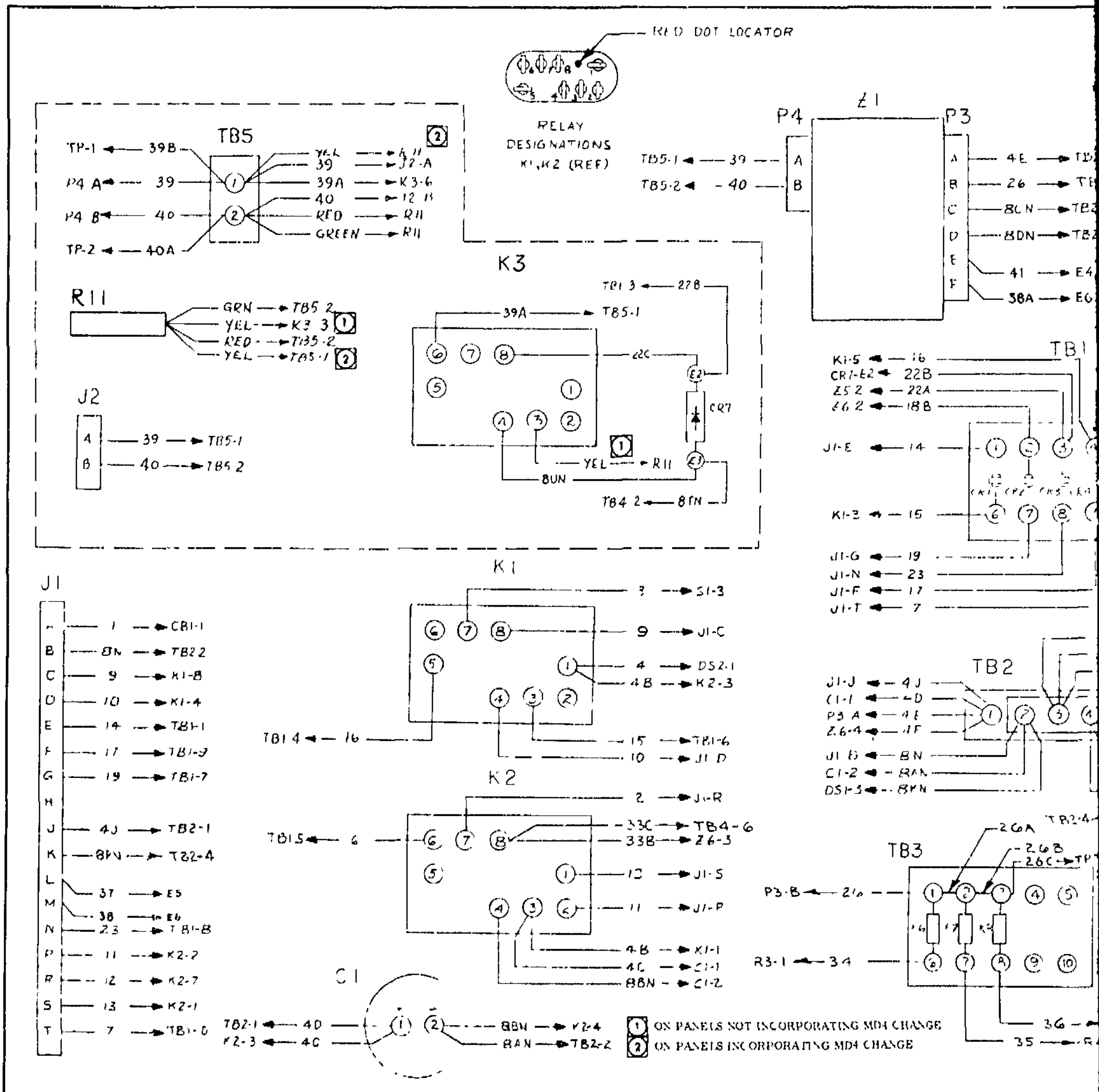



Figure 2-C. Exploded View--Gas Generator High-Low Temperature Cutoff Panel (Sheet 1 of 2)

| Index No. | Part No. | Nomenclature |
|---|---|---|
| 1 | 91047 | Gas generator high-low temperature cutoff panel |
| 2 | 91035 | Timer |
| | LD153-0011-0012 | Washer |
| | NAS679A06W | Nut |
| 3 | 90137 | Timer |
| | LD153-0011-0008 | Washer |
| | NAS679A06W | Nut |
| 4 | 919684 | High-temperature limit switch |
| | LD153-0011-0008 | Washer |
| | AN515-6R6 | Screw |
| 5 | 9019686 | Low-temperature limit switch |
| | LD153-0011-0008 | Washer |
| | AN515-6R6 | Screw |
| 6 | 9019688 | Terminal board |
| | 9019694 | Terminal board |
| | 9019694-11 | Terminal board |
| | AN515-4R32 | Screw |
| | NAS43DDO-16 | Spacer |
| | LD153-0011-0006 | Washer |
| | NAS679A04W | Nut |
| | NAS43DDO-32 | Spacer |
| | NAS43DDO-92 | Spacer |
| | AN515-4R22 | Screw |
| 7 | NA5-27292T1 | Relay |
| | NA5-27292T7[a] | Relay |
| | LD153-0011-0008 | Washer |
| | NAS679A04W | Nut |
| 8 | CE41C500R | Capacitor |
| 9 | 91635 | Amplifier |
| | AN520-10R8 | Screw |
| | LD153-0011-0012 | Washer |
| | NAS679A3W | Nut |
| 10 | AR200KL. 1SS | Potentiometer |
| 11 | AR5KL. 1SS | Potentiometer |
| 12 | AR10KL. 1SS | Potentiometer |
| 13 | MS25089-3C | Switch |
| 14 | 9025111 | Bracket |
| | AN520-10R8 | Screw |
| | AN520-10R10 | Screw |
| | LD153-0011-0012 | Washer |
| | NAS679A3W | Nut |
| | RD417-4001-0002 | Terminal board |
| | NAS1063B-1-2 | Strip |
| | AN515-4R3 | Screw |
| | MS25227-1A | Strip |
| | NAS679A04W | Nut |
| | 3020L-1-502 | Potentiometer |
| | AN515-2R7 | Screw |
| | MS35337-77 | Washer |
| | MS35649-22 | Nut |
| | UT299 | Diode |
| | 760 | Terminal |
| | AN515-4R5 | Screw |
| | MS35337-78 | Washer |
| | SM3100R10SL-53P | Receptacle |
| | AN515-4R8 | Screw |
| | LD153-0011-0006 | Washer |
| | NAS679A04W | Nut |
| 15 | J26B1H6AS | Relay |
| | MS35337-78 | Washer |
| | MS35649-42 | Nut |
| 16 | RD338-0001-0004 | Lampholder |
| | RD332-0003-0234 | Lens |
| 17 | MS35059-24 | Switch |
| 18 | MS25244-5 | Circuit breaker |
| 19 | RD415-3001-0001 | Lampholder |
| | RD450-2001-0001 | Control |
| | RD338-0001-0001 | Filter |
| | RD332-0003-0070 | Lens |
| 20 | DF30RC (TP1, TP3) | Binding post |
| 21 | DF30YC (TP2) | Binding post |
| 22 | DF30BC (TP4) | Binding post |
| 23 | 3010L-1-200M | Potentiometer |

(a) Allowable alternate

Figure 2-6. Exploded View--Gas Generator High-Low Temperature Cutoff Panel (Sheet 2 of 2)


RED DOT LOCATOR
RELAY DESIGNATIONS K1,K2 (REF)
TB5
TP-1 ← 39B
P4 A ← 39
P4 B ← 40
TP-2 ← 40A
YEL → K11
39 → J2-A
39A → K3-6
40 → J2-B
RED → R11
GREEN → R11
R11
GRN → TB5 2
YEL → K3 3
RED → TB5-2
YEL → TB5-1
J2
A — 39 → TB5-1
B — 40 → TB5 2
K3
39A → TB5-1
TB1 3 ← 27B
22C
CR7
YEL → R11
8UN
TB4 2 ← 8BN
Z1
P4
P3
TB5-1 ← 39
TB5-2 ← 40
4E
26
8CN
8DN
41 → E4
38A
TB1
K1-5 ← 16
CR7-E2 ← 22B
Z5 2 ← 22A
Z6 2 ← 18B
J1-E ← 14
K1-3 ← 15
J1-G ← 19
J1-N ← 23
J1-F ← 17
J1-T ← 7
J1
A — 1 → CB1-1
B — BN → TB2 2
C — 9 → K1-8
D — 10 → K1-4
E — 14 → TB1-1
F — 17 → TB1-9
G — 19 → TB1-7
H
J — 4J → TB2-1
K — 8BN → TB2-4
L — 37 → E5
M — 38 → E6
N — 23 → TB1-8
P — 11 → K2-2
R — 12 → K2-7
S — 13 → K2-1
T — 7 → TB1-6
K1
3 → S1-3
9 → J1-C
4 → DS2-1
4B → K2-3
TB1 4 ← 16
15 → TB1-6
10 → J1 D
K2
2 → J1-R
TB1 5 ← 6
33C → TB4-6
33B → Z6-3
13 → J1-S
11 → J1-P
4B → K1-1
4C → C1-1
8BN → C1-2
C1
TB2-1 ← 4D
K2-3 ← 4C
8BN → K2-4
BAN → TB2-2
TB2
J1-J ← 4J
C1-1 ← 4D
P3 A ← 4E
Z6-4 ← 4F
J1 B ← BN
C1-2 ← BAN
DS1-3 ← BYN
TB3
26A
26B
26C
TB2-4
P3-B ← 26
R3-1 ← 34
36
35
1 ON PANELS NOT INCORPORATING MD4 CHANGE
2 ON PANELS INCORPORATING MD4 CHANGE

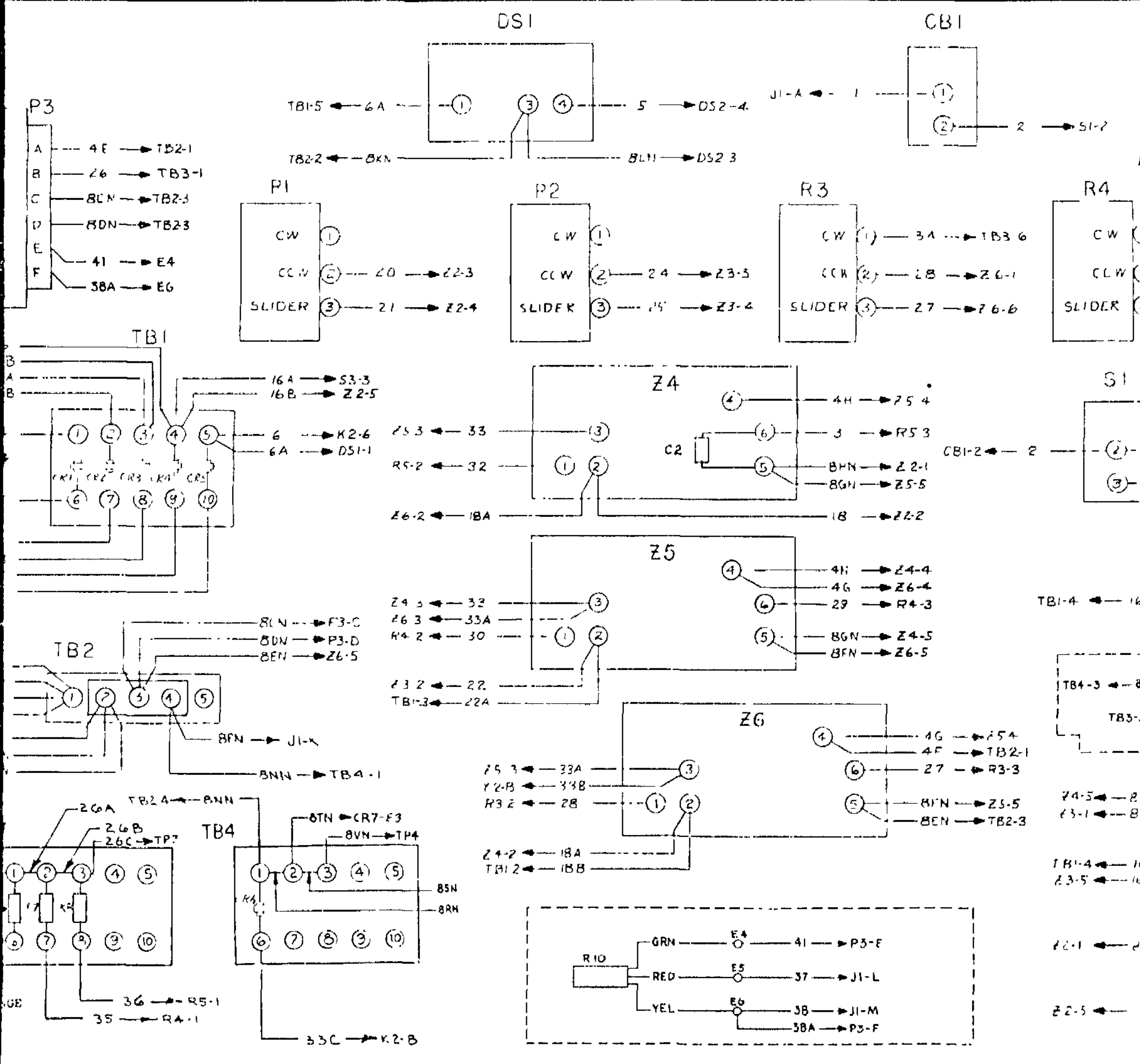



**Figure 2-7. Wiring Diagram--Gas G**

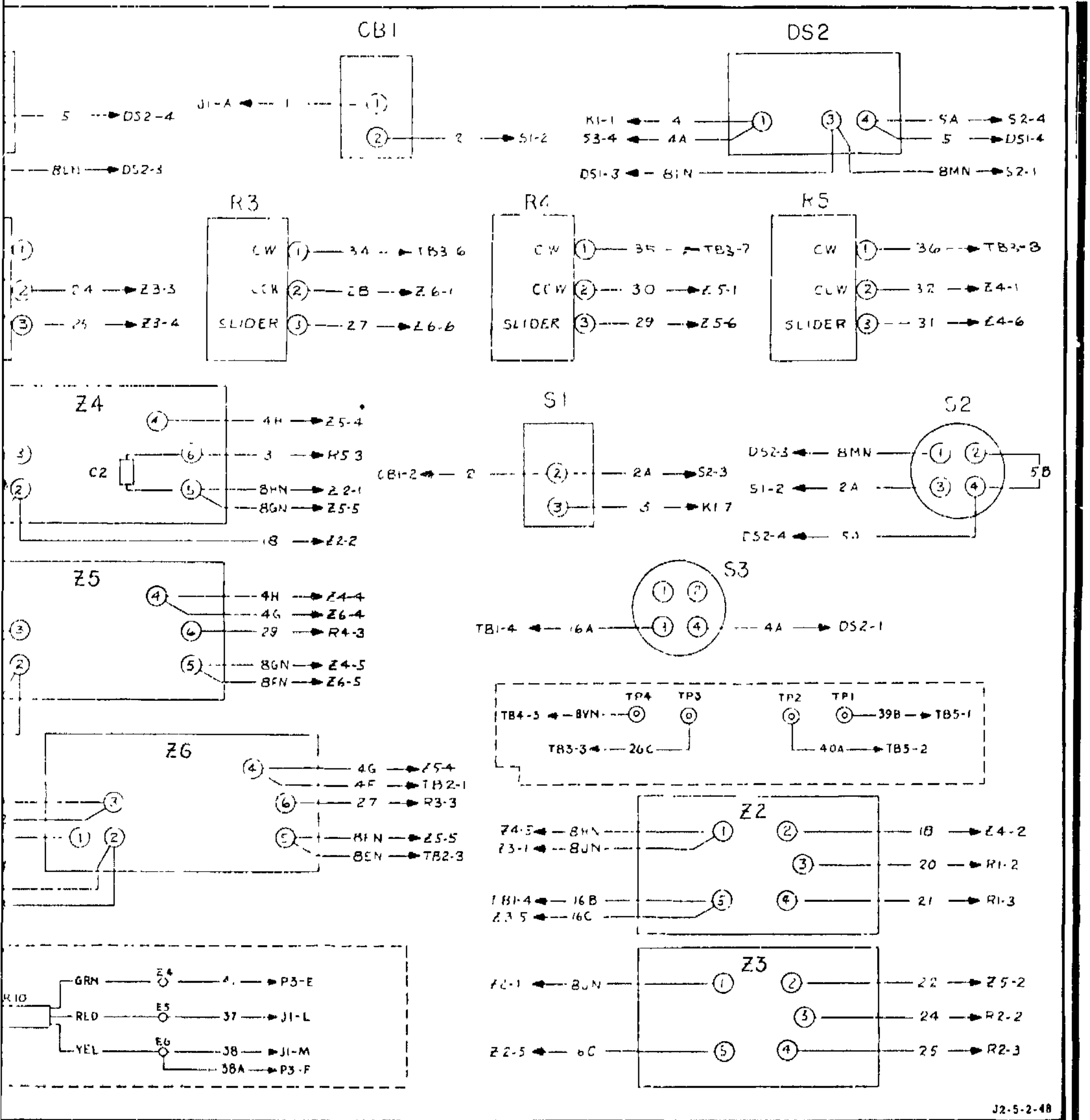



Figure 2-7. Wiring Diagram--Gas Generator High-Low Temperature Cutoff Panel

| Requirements | Location | Remarks |
|---|---|---|
| 19-inch rack | Instrumentation room nearest test stand | Panel is secured to 19-inch mounting rack with 4 screws. Refer to torque table in section I for applicable torque values. |
| One length of thermocouple wire (MIL-W-5846) | Amplifier connector to engine gas generator temperature transducer. Connector SM3106R10SL-53S (Bendix) is used at amplifier receptacle J2. | Weld or braze wire leads to pins at engine gas generator overtemperature transducer electrical connector. Solder wire leads to connector at amplifier. |
| System ground | Panel ground terminal E1 | |
| Facility control and monitoring system | Panel connector J1 | Provide facility 28 ±2 vdc power and monitoring cable to pin connections shown in figure 2-4. |

Figure 2-8. Installation Requirements--Gas Generator High-Low Temperature Cutoff Panel

## 2-23. FUNCTION-TESTING GAS GENERATOR HIGH-LOW TEMPERATURE CUTOFF PANEL.

2-24. The gas generator high-low temperature cutoff panel function test consists of test preparation and the adjustment of amplifier Z1, testing high-temperature limit switch Z6, testing medium-temperature limit switch Z5, testing low-temperature limit switch Z4, testing relays and timers, and a test-termination procedure. The function test provides a check of each component in its active (energized) and inactive (normal or deenergized) mode, as applicable, and must be performed in the order presented. The tests must be performed at a temperature of 75 ±25° F, and personnel must observe all necessary safety precautions applicable to electrical equipment. See figures 2-9, 2-10, and 2-11 for test equipment required, setup of calibration test equipment, and the nomenclature used in the test. Perform the test as specified in sections A through F of figure 2-12. In the event a result is not obtained, or an unspecified result occurs, refer to paragraph 2-25. Voltages obtained in tests are to be recorded, together with date of test, and kept with panel as an aid in determining component deterioration. (Compare recorded voltages with values stamped in white on top of amplifier.) Record voltages as follows:

2200° F = "A" vdc
2000° F = "B" vdc
1550° F = "C" vdc
250° F = "D" vdc

| Part Number and Manufacturer | Nomenclature | Use |
|---|---|---|
| None | DC power supply (0-30 volts, 100 volt-amperes) | To provide 28 vdc during function test |
| Model 7553-K3 or Model 8691 (Leeds and Northrup) or Model 825 (John Fluke) | Potentiometer | To monitor amplifier input and amplifier output recorder voltages during calibration and function test. |
| None | DC variable power supply (0-60 millivolts with 10 ohms maximum impedance output and 3 milliwatts maximum load) | To provide voltage input to amplifier during calibration test and function test (See figure 2-10.) |
| Model AW (Ester-Angus), or equivalent | Pen recorder | To monitor timer setting and output during calibration test and function test |
| None | AC power supply (115 ±5 volts, 60-cycle, 2,400 volt-amperes) | To provide power to recorder during function test |
| None | Thermocouple wire (MIL-W-5846), premium grade (3-6 feet) | To provide test thermocouple wire to amplifier during calibration test and function test |
| None | Ice water containers (Dewars) | To immerse thermocouple in during calibration test and function test |
| Model 803B (John Fluke Co) | Vacuum tube voltmeters (0-35 vdc, ±3% accuracy) | To measure voltage and resistance during calibration test and function test |

Figure 2-9. Test Equipment--Gas Generator High-Low Temperature Cutoff Panel

2-25. TROUBLESHOOTING. When a panel fails to achieve the REQUIRED RESULT during function testing (figure 2-12), a trouble analysis should be made, as follows:

a. Consider the possibility of human error. Review test procedure to determine that operations were accurately performed and connections properly made.

b. Consider the possibility of test equipment failure. Examine test equipment to verify that it is performing as required.

c. Terminate function test. Perform section F of figure 2-12.

d. Identify probable failed component. Figure 2-14 lists each component and refers to step in function test in which failure might occur. The function test (figure 2-12) provides a check of each component in its active (energized) mode and in its inactive (normal or deenergize) mode where applicable.

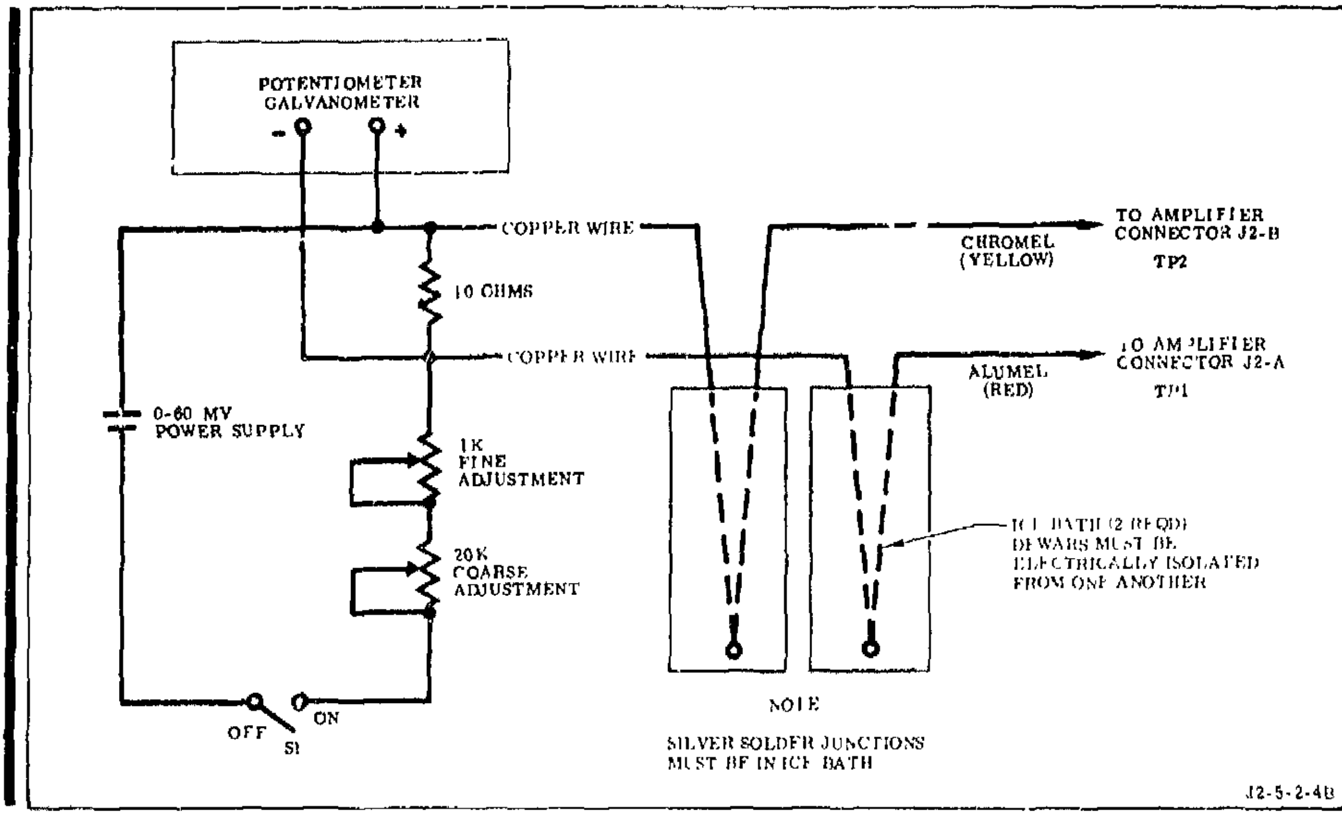



Figure 2-10. Calibration Test Equipment Setup--Gas Generator High-Low Temperature Cutoff Panel

e. Perform a continuity check of connections and wiring associated with probable failed component. (See figures 2-7 and 2-4.) Repair connections and wiring as necessary.

f. Repeat function-test. If failure is repeated, replace probable failed component.

2-26. CALIBRATING GAS GENERATOR HIGH-LOW TEMPERATURE CUTOFF PANEL.

2-27. Calibration of the gas generator high-low temperature cutoff panel consists of adjusting the timers and temperature limit switches to time and voltage values that represent time and temperature limits specified in R-3825-1B. See figure 2-15 for temperature and voltage calibration equivalents. See figures 2-9, 2-10, and 2-11 for test equipment required, setup of calibration test equipment, and the nomenclature used in the calibration procedure. Calibration must be performed at a temperature of 75 ±25° F, and personnel must observe all necessary safety precautions applicable to electrical equipment. Calibrate the panel as specified in figure 2-16.

2-28. <u>STORING GAS GENERATOR HIGH-LOW TEMPERATURE CUTOFF PANEL AND COMPONENTS.</u>

2-29. STORING PANEL. Prepare gas generator high-low temperature panel for storage as follows:

a. Clean panel and components. (Refer to R-3825-5, Volume I.

b. Install protective covers on electrical connectors.

c. Wrap panel with greaseproof barrier material (MIL-B-121, Grade A), or equivalent, and seal wrapping to protect panel from dust.

2-30. STORING COMPONENTS. Prepare component that is separated from gas generator high-low temperature panel for storage as follows (as applicable):

a. Remove any excess solder from component terminals.

b. Clean component. Refer to R-3825-5, Volume I.

c. Install protective cover on electrical connector.

d. Wrap component with greaseproof barrier material (MIL-B-121, Grade A), or equivalent, and seal ends.

e. Identify wrapped component and place in a plastic bag. Seal bag.

| Component or Adjustment | Placarded Nomenclature | | | | | Nomenclature Used in Procedures |
|---|---|---|---|---|---|---|
| | Basic Config-uration | As Changed By | | | | |
| | | MD1 | MD2 | MD3 | MD4 | |
| Zero-adjustment amplifier Z1 | ZERO ADJUST | | | | | ZERO ADJUST |
| Gain-adjustment amplifier Z1 | GAIN ADJUST | | | | | GAIN ADJUST |
| 0.05 to 1.0 second timer Z2 | .05 - 1.0 | | | Z2 | | Z2 |
| 0.4 to 8.0 second timer Z3 | 0.4 - 8.0 | | | Z3 | | Z3 |
| Low-temperature limit switch Z4 | 200° - 400° | | 150° - 400° | Z4 | | Z4 |
| Medium-temperature limit switch Z5 | 1300° - 1700° | | | Z5 | | Z5 |
| High-temperature limit switch Z6 | 2700° - 3200° | | | Z6 | | Z6 |
| Lamp test switch | LAMP TEST | | | | | LAMP TEST |
| Calibration switch | TEST | | | CAL TEST | | CAL TEST |
| Power switch | DC POWER | | | | | DC POWER |
| Circuit breaker | 28 VDC | | | | | 28 VDC |
| Amplifier-loading resistor (potentiometer) | | | | R10 | | R10 |
| Safety circuit resistor (potentiometer) | | R11 | | | | R11 |
| Abbreviations | | | | | | |
| Location of operation or result | | | | | | LOC |
| Panel | | | | | | PAN |
| Test equipment | | | | | | EQP |
| Facility | | | | | | FAC |
| Vacuum tube voltmeter | | | | | | VTVM |

Figure 2-11. Test Nomenclature--Gas Generator High-Low Temperature Cutoff Panel

| Step | LOC[a] | Operation | LOC[a] | Result |
|---|---|---|---|---|
| A | TEST PREPARATION AND AMPLIFIER ADJUSTMENT | | | |
| A1 | PAN | a. Make sure DC POWER switch is in OFF position. | | |
| | PAN | b. Make sure 28 VDC circuit breaker is in pulled-out position. | | |
| | PAN | c. Make sure cables are not connected to receptacles J1 or J2. | | |
| A2 | PAN | a. Open access cover (for access to time and temperature adjustments). | | |
| | PAN | b. Release potentiometer shaft lock and turn adjustments Z3 and Z4 fully clockwise. | | |
| | PAN | c. Release potentiometer shaft locks and turn adjustments Z3, Z5, and Z6 fully counter-clockwise. | | |
| A3 | PAN | Turn adjustment R11 fully clockwise. (Adjustment R11 is a 25-turn potentiometer.) | | |
| A4 | PAN | a. Connect vacuum tube voltmeter (ohmmeter) leads to receptacle J1 contacts J1-L and J1-M. | | |
| | PAN | b. Turn adjustment R10 as necessary to obtain result. | EQP | Meter indication varies between approximately zero ohms and 20 ±1 ohms. |
| | PAN | c. Adjust R10 to obtain result. | EQP | Meter indicates 20 ±1 ohms. |
| | PAN | d. Disconnect vacuum tube voltmeter (ohmmeter) from panel. | | |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-12. Function-Testing Gas Generator High-Low Temperature Cutoff Panel (Sheet 1 of 14)

| Step | LOC(a) | Operation | LOC(a) | Result |
|---|---|---|---|---|
| A5 | PAN | a. Connect a length of Alumel thermocouple lead to test jack TP1 (or to receptacle contact J2-A). | | |
| | PAN | b. Connect a length of Chromel thermocouple lead to test jack TP2 (or to receptacle contact J2-B). | | |
| | EQP | c. Clean and twist free ends of thermocouple leads together. (Make sure twisted ends form an electrical connection.) | | |
| | EQP | d. Immerse twisted thermocouple ends in ice bath. | | |
| A6 | PAN | a. Connect positive lead of VTVM to test jack TP3 (or to terminal post TB3-1). | | |
| | PAN | b. Connect negative lead of VTVM to test jack TP4 (or to terminal post TB2-4). | | |
| A7 | PAN | a. Connect facility 28 ±2 vdc power supply positive leads (power off) to receptacle contacts J1-A and J1-R. | | |
| | PAN | b. Connect facility 28 ±2 vdc power supply negative leads to receptacle contacts J1-B and J1-D. | | |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-12. Function-Testing Gas Generator High-Low Temperature Cutoff Panel (Sheet 2 of 14)

| Step | LOC(a) | Operation | LOC(a) | Result |
|---|---|---|---|---|
| A8 | EQP | a. Energize facility 28 ±2 vdc power supply to panel. | PAN | No visible result |
| | PAN | b. Momentarily depress LAMP TEST switch. | PAN | No visible result |
| | PAN | c. Depress 28 VDC circuit breaker to pushed-in position. | PAN | No visible result |
| | PAN | d. Momentarily depress LAMP TEST switch. (If lights fail to come on, replace lamps and repeat step.) | PAN | DC POWER ON and CUTOFF lights come on, then go off. |
| | PAN | e. Move DC POWER switch to ON position. | PAN | DC POWER ON light comes on. (CUTOFF light stays off.) |
| | PAN | f. Allow panel to warm up approximately 15 minutes. | | |
| A9 | PAN | a. Adjust amplifier Z1 by turning ZERO ADJUST (on amplifier) to obtain result. | EQP | VTVM indicates 0.0 ±0.1 vdc when nulled. |
| | PAN | b. Disconnect thermocouple leads from panel. | | |
| A10 | EQP | a. Prepare calibration test equipment as shown in figure 2-10. (The monitoring potentiometer may be used as the potentiometer galvanometer indicated in figure 2-10; however, the potentiometer leads must be connected and reconnected, as necessary, to meet both requirements.) | | |
| | PAN | b. Connect Alumel thermocouple lead from calibration test equipment (step a) to test jack TP1 (or to receptacle contact J2-A). | | |
| | PAN | c. Connect Chromel thermocouple lead from calibration test equipment (step a) to test jack TP2 (or to receptacle contact J2-B). | | |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-12. Function-Testing Gas Generator High-Low Temperature Cutoff Panel (Sheet 3 of 14)

| Step | LOC(a) | Operation | LOC(a) | Result |
|---|---|---|---|---|
| A11 | EQP | a. Adjust calibration test equipment to provide voltages specified. Adjust coarse and fine adjustments (potentiometers), and adjust potentiometer galvanometer to null at required voltage. (In order to preserve batteries, switch S1 (figure 2-10) should be in closed position only as necessary to adjust voltage output and to accomplish test.) | EQP | 0.03507 ±0.00010 vdc |
| | PAN | b. Adjust amplifier Z1 by turning GAIN ADJUST until VTVM indicates required result. | EQP | 21.042 ±0.100 vdc |
| B | | TESTING HIGH-TEMPERATURE LIMIT SWITCH Z6 | | |
| B1 | EQP | a. Make sure that calibration test equipment provides result. | EQP | 0.04905 ±0.00010 vdc to panel |
| | PAN | b. Connect positive lead of monitoring potentiometer to receptacle contact J1-L (or terminal post E5). | | |
| | PAN | c. Connect negative lead of monitoring potentiometer to receptacle contact J1-M (or terminal post E6). | | |
| B2 | PAN | a. Press and hold CAL TEST switch. | | |
| | | b. Wait one second (minimum). | | |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-12. Function Testing Gas Generator High-Low Temperature Cutoff Panel (Sheet 4 of 14)

| Step | LOC[a] | Operation | LOC[a] | Result |
|---|---|---|---|---|
| | PAN | c. Slowly turn adjustment Z6[a] clockwise until result occurs. | PAN | CUTOFF light comes on. |
| | EQP | d. Observe and record monitoring potentiometer voltage (connected in step B1). Identify as voltage A. | | |
| | EQP | e. Momentarily interrupt voltage provided by calibration test equipment. (Open switch S1, figure 2-10, or disconnect lead to test jack TP1; then close switch or reconnect lead.) | PAN | CUTOFF light remains on. |
| | PAN | f. Release CAL TEST switch. | PAN | CUTOFF light goes off. |
| B3 | PAN | a. Turn adjustment Z6[a] fully counterclockwise. | | |
| | EQP | b. Adjust calibration test equipment to provide result. | EQP | 0.03843 ±0.00010 vdc |
| | PAN | c. Press and hold CAL TEST switch[a]. | | |
| | | d. Wait one second (minimum). | | |
| | PAN | e. Slowly turn adjustment Z6 clockwise until result occurs. | PAN | CUTOFF light comes on. |
| | EQP | f. Momentarily interrupt voltage provided by calibration test equipment. (Open switch S1, figure 2-10, or disconnect lead to test jack TP1; then close switch or reconnect lead.) | PAN | CUTOFF light remains on. |
| | PAN | g. Release CAL TEST switch. | PAN | CUTOFF light goes off. |
| B4 | PAN | a. Turn adjustment Z6[a] fully counterclockwise. | | |
| | EQP | b. Adjust calibration test equipment to provide result. | EQP | 0.04491 ±0.00010 vdc |
| | PAN | c. Press and hold CAL TEST switch[a]. | | |
| | | d. Wait one second (minimum). | | |
| | PAN | e. Slowly turn adjustment Z6[a] clockwise until result occurs. | PAN | CUTOFF light comes on. |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-12. Function-Testing Gas Generator High-Low Temperature Cutoff Panel (Sheet 5 of 14)

| Step | LOC(a) | Operation | LOC(a) | Result |
|---|---|---|---|---|
| | EQP | f. Momentarily interrupt voltage provided by calibration test equipment. (Open switch S1, figure 2-10, or disconnect lead to test jack TP1; then close switch or reconnect lead.) | PAN | CUTOFF light remains on. |
| | PAN | g. Release CAL TEST switch. | PAN | CUTOFF light goes off. |
| | EQP | h. Observe and record monitoring potentiometer voltage. Identify as voltage B. | | |
| B5 | EQP | a. Adjust calibration test equipment to provide result. | EQP | 0.0400 vdc (maximum) |
| | PAN | b. Press and hold CAL TEST switch(a). | | |
| | | c. Wait one second(minimum). | | |
| | EQP | d. Slowly increase voltage provided by calibration test equipment until result occurs. | PAN<br>EQP | CUTOFF light comes on at a voltage between 0.04278 and 0.04700 vdc |
| | PAN | e. Release CAL TEST switch. | PAN | CUTOFF light goes off. |
| C | TEST MEDIUM-TEMPERATURE LIMIT SWITCH Z5 | | | |
| C1 | EQP | a. Adjust calibration test equipment to provide result. | EQP | 0.03843 ±0.00010 vdc |
| | PAN | b. Press and hold CAL TEST switch(a). | | |
| | | c. Wait 8 seconds (minimum). | | |
| | PAN | d. Slowly turn adjustment Z5(a) clockwise until result occurs. | PAN | CUTOFF light comes on. |
| | EQP | e. Momentarily interrupt voltage provided by calibration test equipment. (Open switch S1, figure 2-10, or disconnect lead to test jack TP1; then close switch or reconnect lead.) | PAN | CUTOFF light remains on. |
| | PAN | f. Release CAL TEST switch. | PAN | CUTOFF light goes off. |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-12. Function-Testing Gas Generator High-Low Temperature Cutoff Panel (Sheet 6 of 14)

| Step | LOC[a] | Operation | LOC[a] | Result |
|---|---|---|---|---|
| C2 | PAN | a. Turn adjustment Z5[a] fully counterclockwise. | | |
| | EQP | b. Adjust calibration test equipment to provide result. | EQP | 0.02932 ±0.00010 vdc |
| | PAN | c. Press and hold CAL TEST switch[a]. | | |
| | PAN | d. Wait 8 seconds (minimum). | | |
| | PAN | e. Slowly turn adjustment Z5 clockwise until result occurs. | PAN | CUTOFF light comes on. |
| | EQP | f. Momentarily interrupt voltage provided by calibration test equipment. (Open switch S1, figure 2-10, or disconnect lead to test jack TP1; then close switch or reconnect lead.) | PAN | CUTOFF light remains on. |
| | PAN | g. Release CAL TEST switch. | PAN | CUTOFF light goes off. |
| C3 | PAN | a. Turn adjustment Z5[a] fully counterclockwise. | | |
| | EQP | b. Adjust calibration test equipment to provide result. | EQP | 0.03507 ±0.00010 vdc |
| | PAN | c. Press and hold CAL TEST switch[a]. | | |
| | | d. Wait 8 seconds (minimum). | | |
| | PAN | e. Slowly turn adjustment Z5 clockwise until result occurs. | PAN | CUTOFF light comes on. |
| | EQP | f. Momentarily interrupt voltage provided by calibration test equipment. (Open switch S1, figure 2-10, or disconnect lead to test jack TP1; then close switch or reconnect lead.) | PAN | CUTOFF light remains on. |
| | PAN | g. Release CAL TEST switch. | PAN | CUTOFF light goes off. |
| | EQP | h. Observe and record monitoring potentiometer voltage. Identify as voltage C. | | |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-12. Function-Testing Gas Generator High-Low Temperature Cutoff Panel (Sheet 7 of 14)

| Step | LOC(a) | Operation | LOC(a) | Result |
|---|---|---|---|---|
| C4 | EQP | a. Adjust calibration test equipment to provide result. | EQP | 0.03200 vdc (maximum) |
| | PAN | b. Press and hold CAL TEST switch. | | |
| | | c. Wait 8 second (minimum). | | |
| | EQP | d. Slowly increase voltage provided by calibration test equipment until result occurs. | PAN<br>EQP | CUTOFF light comes on at a voltage between 0.03393 and 0.03619 vdc. |
| | PAN | e. Release CAL TEST switch. | PAN | CUTOFF light goes off. |
| D | TESTING LOW-TEMPERATURE LIMIT SWITCH Z4 | | | |
| D1 | EQP | a. Adjust calibration test equipment to provide result. | EQP | 0.00831 ±0.00010 vdc |
| | PAN | b. Press and hold CAL TEST switch. | PAN | CUTOFF light comes on within one second. |
| | PAN | c. Slowly turn adjustment Z4 clockwise until result occurs. | PAN | CUTOFF light goes off. |
| | PAN | d. Release CAL TEST switch. | | |
| D2 | PAN | a. Turn adjustment Z4 fully counterclockwise. | | |
| | EQP | b. Adjust calibration test equipment to provide result. | EQP | 0.00266 to 0.00286 vdc to panel |
| | PAN | c. Press and hold CAL TEST switch. | PAN | CUTOFF light comes on within one second. |
| | PAN | d. Slowly turn adjustment Z4 clockwise until result occurs. | PAN | CUTOFF light goes off. |
| | PAN | e. Release CAL TEST switch. | | |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-12. Function-Testing Gas Generator High-Low Temperature Cutoff Panel (Sheet 8 of 14)

| Step | LOC[a] | Operation | LOC[a] | Result |
|---|---|---|---|---|
| D3 | PAN | a. Turn adjustment Z4[a] fully counterclockwise. | | |
| | EQP | b. Adjust calibration test equipment to provide result. | EQP | 0.00497 ±0.00010 vdc to panel |
| | PAN | c. Press and hold CAL TEST switch. | PAN | CUTOFF light comes on within one second. |
| | PAN | d. Slowly turn adjustment Z4 clockwise until result occurs. | PAN | CUTOFF light goes off. |
| | PAN | e. Release CAL TEST switch. | | |
| | EQP | f. Observe and record monitoring potentiometer voltage. Identify as voltage D. | | |
| D4 | EQP | a. Adjust calibration test equipment to provide result. | EQP | 0.00725 vdc (minimum) |
| | PAN | b. Press and hold CAL TEST switch[a]. | | |
| | | c. Wait one second (minimum). | | |
| | EQP | d. Adjust calibration test equipment to provide result. | EQP | 0.00200 vdc (maximum) |
| | PAN | e. Momentarily apply a positive voltage from 28 ±2 vdc facility power supply to receptacle contact J1-C. | PAN | DC POWER ON light goes off momentarily. CUTOFF light comes on (when DC POWER ON light comes on). |
| | EQP | f. Slowly increase voltage provided by calibration test equipment until result occurs. | PAN<br>EQP | CUTOFF light goes off at voltage between 0.00266 and 0.00720 vdc. |
| | | g. Release CAL TEST switch. | | |

(a) See figure 2-11 for abbreviations and nomenclature

Figure 2-12. Function-Testing Gas Generator High-Low Temperature Cutoff Panel (Sheet 9 of 14)

| Step | LOC(a) | Operation | LOC(a) | Result |
|---|---|---|---|---|
| E | TESTING RELAYS AND TIMERS | | | |
| E1 | EQP | a. Deenergize 28 ±2 vdc facility power supply to panel. | PAN | DC POWER ON light goes off. |
| | PAN | b. Disconnnect monitoring potentiometer leads from panel (receptacle contacts J1-L and J1-M or terminal posts E5 and E6). | | |
| | PAN | c. Connect VTVM leads to test jacks TP3 (positive) and TP4 (negative). (Refer to applicable steps of test A6.) | | |
| | PAN | d. Connect pen recorder channel leads (positive) to receptacle contacts J1-F, J1-G, J1-J, J1-N, J1-P, J1-S, and J1-T. | | |
| | PAN | e. Connect pen recorder negative lead to receptacle contact J1-K. | | |
| | EQP | f. Make sure pen recorder is set to operate at fast speed (approximately 3 inches per second). | | |
| | EQP | g. Energize 28 ±2 vdc facility power supply to panel. (J1-A and J1-R are positive; J1-B and J1-D are negative.) | PAN | DC POWER ON light comes on. |
| E2 | EQP | a. Adjust calibration test equipment to provide result. | EQP | 0.00200 ±0.00010 vdc to panel |
| | PAN | b. Momentarily apply a positive voltage from 28 ±2 vdc facility power supply to receptacle contact J1-C. | PAN | DC POWER ON light goes off momentarily. |
| | EQP | c. Start pen recorder | | |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-12. Function-Testing Gas Generator High-Low Temperature Cutoff Panel (Sheet 10 of 14)

| Step | LOC[a] | Operation | LOC[a] | Result |
|---|---|---|---|---|
| | PAN | d. Apply (and hold) a positive voltage from 28 ±2 vdc facility power supply to receptacle contact J1-E. | | |
| | | e. Wait 2 seconds. (CUTOFF light comes on when timer Z2 expires.) | | |
| | PAN | f. Momentarily apply positive voltage from 28 ±2 vdc facility power supply to receptacle contact J1-C. | PAN | DC POWER ON light goes off momentarily. CUTOFF light goes off. |
| | | g. Wait 8 seconds. (CUTOFF light comes on when timer Z2 expires.) | | |
| | PAN | h. Remove voltage from J1-E. | | CUTOFF light goes off. |
| | EQP | i. Stop pen recorder. | | |
| | EQP | j. Check pen recorder chart paper for required results. (See figure 2-13.) | EQP | Recorder indicates receipt of the following signals:<br>(1) MAINSTAGE (J1-F) (energized in step d, interrupted in step f, and deenergized in step h).<br>(2) Timer Z2 (J1-G) (energized in steps d and f provide signal after 0.05 to 1.0 second).<br>(3) Timer Z3 (J1-N), (energized in step f, provide signal after 0.4 to 8.0 seconds).<br>(4) DC POWER ON (J1-J) (energized at start (step c) and interrupted in step f).<br>(5) CUTOFF (J1-P, and J1-T) (signals generated when timer Z2 expires J1-S signal lost when timer Z2 expires). |
| E3 | EQP | a. Start pen recorder. | | |
| | PAN | b. Press and hold CAL TEST switch[a]. | | |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-12. Function-Testing Gas Generator High-Low Temperature Cutoff Panel (Sheet 11 of 14)

| Step | LOC(a) | Operation | LOC(a) | Result |
|---|---|---|---|---|
| | | c. Wait 8 seconds. (CUTOFF light comes on when timer Z2 expires.) | | |
| | PAN | d. Release CAL TEST switch. | | |
| | EQP | e. Stop pen recorder. | | |
| | EQP | f. Check pen recorder chart paper for required results. (If result is not as required, turn adjustment Z2 or Z3 in a clockwise direction (or counter-clockwise), as necessary; then repeat test E3 (a through f) until required result is obtained.) (See figure 2-13.) | EQP | Recorder indicates that time interval between MAINSTAGE signal (J1-F) and timer Z2 signal (J1-G) is 0.50 ±0.05 second and interval between MAINSTAGE signal (J1-F) and timer Z3 signal (J1-N) is 3.50 ±0.35 seconds. |
| E4 | EQP | a. Adjust calibration test equipment to provide result. | EQP | 0.01753 to 0.01775 vdc |
| | PAN | b. Press and hold CAL TEST switch. | | |
| | | c. Wait 4 seconds (minimum). (Disregard CUTOFF light if it comes on.) | | |
| | | d. Interrupt voltage provided by calibration test equipment. (Open switch S1, figure 2-10, or disconnect lead to test jack TP1.) | | |
| | EQP | e. Observe VTVM for required result. (If result is not as required, turn adjustment R11 in a counterclockwise or clockwise direction as necessary, perform steps f and g, and repeat test beginning with step a until required result is obtained.) | EQP | 10.46 to 10.58 vdc on panel |
| | PAN | f. Release CAL TEST switch. | | |
| | EQP | g. Close switch S1, or reconnect lead to test jack TP1. (Refer to step d.) | | |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-12. Function-Testing Gas Generator High-Low Temperature Cutoff Panel (Sheet 12 of 14)

| Step | LOC[a] | Operation | LOC[a] | Result |
|---|---|---|---|---|
| E5 | PAN | a. Press and hold CAL TEST switch. | | |
| | | b. Wait 4 seconds (minimum). | | |
| | EQP | c. Momentarily interrupt voltage provided by calibration test equipment. (Open switch S1, figure 2-10, or disconnect lead to test jack TP1; then close switch or reconnect lead.) | PAN | No visible result |
| | PAN | d. Release CAL TEST switch. | PAN | No visible result |
| E6 | PAN | a. Press and hold CAL TEST switch. | | |
| | | b. Wait one second (minimum), but perform step c within 3 seconds (maximum) of step a. (Step c is to be performed between the expiration times of timers Z2 and Z3.) | | |
| | EQP | c. Momentarily interrupt voltage provided by calibration test equipment. (Open switch S1, figure 2-10, or disconnect lead to test jack TP1; then close switch or reconnect lead.) | PAN | (1) No visible result on panel incorporating MD4 change |
| | | | PAN | (2) CUTOFF light comes on (and remains on) on panel not incorporating MD4 change. |
| | PAN | d. Release CAL TEST switch. | PAN | (1) No visible result on panel incorporating MD4 change |
| | | | PAN | (2) CUTOFF light goes off on panel not incorporating MD4 change. |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-12. Function-Testing Gas Generator High-Low Temperature Cutoff Panel (Sheet 13 of 14)

| Step | LOC(a) | Operation | LOC(a) | Result |
|---|---|---|---|---|
| F | TEST TERMINATION PROCEDURE | | | |
| | PAN | a. Move DC POWER switch to OFF position. | | |
| | EQP | b. Deenergize calibration test equipment. (Open switch S1, figure 2-10.) | | |
| | EQP | c. Deenergize 28 ±2 vdc facility power supply. | | |
| | PAN | d. Remove all test equipment from panel. | | |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-12. Function-Testing Gas Generator High-Low Temperature Cutoff Panel (Sheet 14 of 14)

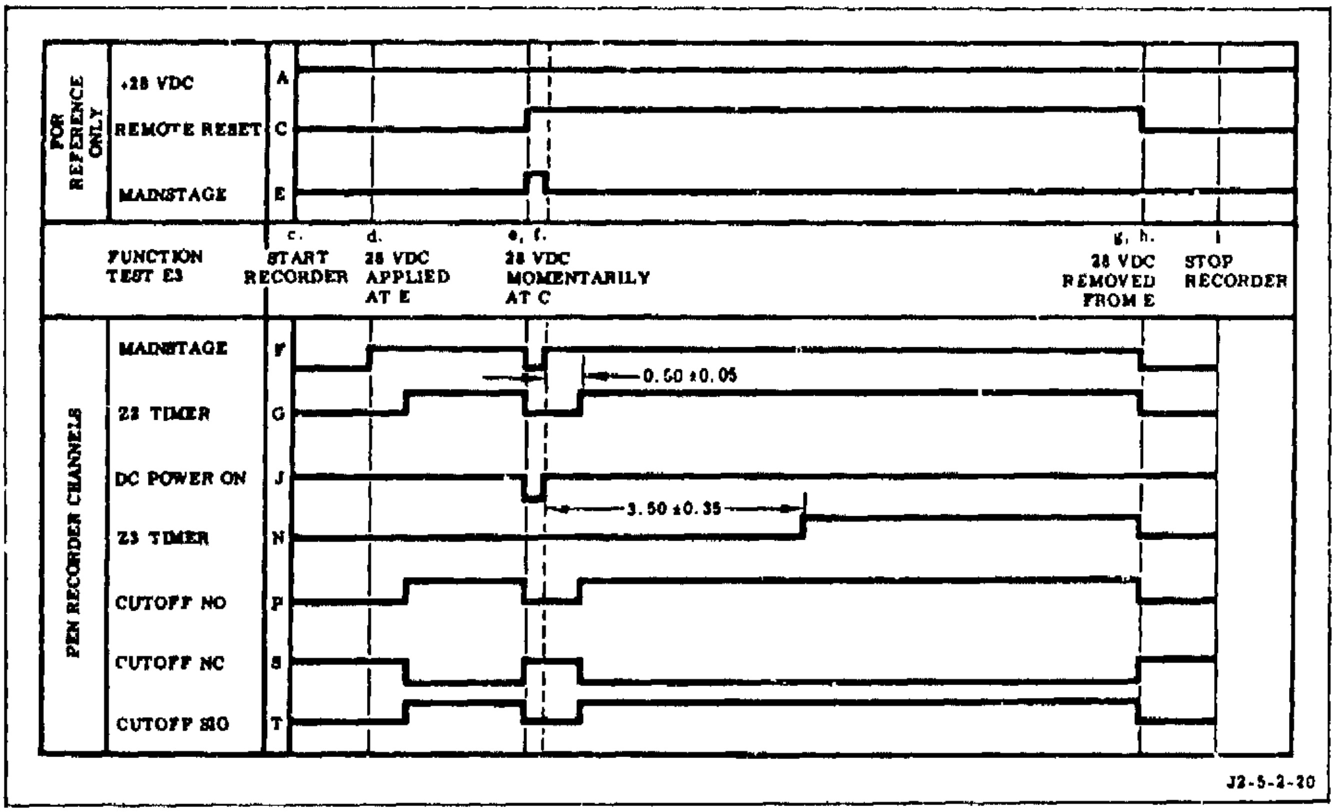



Figure 2-13. Pen Recorder Traces--Gas Generator High-Low Temperature Cutoff Panel

| Step of Function Test in Which Trouble Occurred[a] | | Probable Failed Component | Component[c] | Function[b][c] |
|---|---|---|---|---|
| Inactive Mode | Active Mode | | | |
| A4b, c | A9, A11 | R10 | Resistor (potentiometer) | Amplifier loading |
| A8a, b | A8d | CB1 | Circuit breaker | |
| A8c | A8e | S1 | Switch | DC POWER |
| A8c | A8d | S2 | Switch | LAMP TEST |
| E2b | B2 | S3 | Switch | CAL TEST |
| A8d | A8d, B2d | DS1 | Light | CUTOFF |
| A8d | A8d, e | DS2 | Light | DC POWER ON |
| - | A8e | C1 | Capacitor | Power |
| - | D2 | C2 | Capacitor | Signal |
| A8e, E2j | E2b | K1 | Relay | Reset |
| A8e, E2j | B2d | K2 | Relay | Cutoff |
| E7 | E4, E5 | K3 | Relay | Safety circuit |
| - | A9, A11 | Z1 | Amplifier | |
| B, D | E3 | Z2 | Timer | 0.05-1.0 second |
| C | E3 | Z3 | Timer | 0.4-8.0 second |
| - | D1-D4 | Z4 | Limit switch | Low-temperature |
| - | C1-C4 | Z5 | Limit switch | Medium-temperature |
| - | B2-B5 | Z6 | Limit switch | High-temperature |
| - | E3 | R1 | Potentiometer Z2 | Adjustment |
| - | E3 | R2 | Potentiometer Z3 | Adjustment |
| A11 | B2-B5 | R3 | Potentiometer Z6 | Adjustment |
| A11 | C1-C4 | R4 | Potentiometer Z5 | Adjustment |
| A11 | D1-D4 | R5 | Potentiometer Z4 | Adjustment |
| - | A11b, B | R6 | Resistor Z6 | Bias |
| - | A11b, C | R7 | Resistor Z5 | Bias |
| - | A11b, D | R8 | Resistor Z4 | Bias |
| - | E4e | R11 | Resistor (potentiometer) | Safety circuit |
| - | E2j | CR1 | Diode | Mainstage signal isolation (input) |
| - | E2j | CR2 | Diode | Z2 timer isolation |
| - | E3f | CR3 | Diode | Z3 timer isolation |
| - | E2e | CR4 | Diode | Mainstage signal isolation (recorder) |
| - | E2j | CR5 | Diode | Cutoff signal isolation |
| - | B2d | CR6 | Diode | Relay isolation (K2 coil) |
| - | E4 | CR7 | Diode | Relay isolation (K3 coil) |

(a) See figure 2-12.
(b) See figure 2-4.
(c) See figure 2-11.

Figure 2-14. Troubleshooting Gas Generator High-Low Temperature Cutoff Panel

| Adjustment | Temperature (°F) | Equivalent Voltage (vdc)[a] |
|---|---|---|
| Limit switch Z4 | 150 | 0.00266 |
| | 180 | 0.00336 |
| | 200 | 0.00382 |
| | 210 | 0.00405 |
| | 300 | 0.00609 |
| | 400 | 0.00831 |
| Resistor (potentiometer) R11 | 800 | 0.01753 |
| Limit switch Z5 | 1,300 | 0.02932 |
| | 1,400 | 0.03165 |
| | 1,450 | 0.03279 |
| | 1,500 | 0.03393 |
| | 1,600 | 0.03619 |
| | 1,700 | 0.03843 |
| Limit switch Z6 | 1,700 | 0.03843 |
| | 1,800 | 0.04062 |
| | 1,900 | 0.04278 |
| | 2,000 | 0.04491 |
| | 2,100 | 0.04700 |
| | 2,200 | 0.04905 |

(a) Voltage applied with calibration test equipment. (See figure 2-10.)

Figure 2-15. Calibration Equivalents--Gas Generator High-Low Temperature Cutoff Panel

| Step | LOC[a] | Operation | LOC[a] | Result |
|---|---|---|---|---|
| 1 | | Prepare facility to provide voltages as follows: | | |
| | FAC | a. 28 ±2 vdc positive voltage to connector contacts J1-A and J1-R | | |
| | FAC | b. 28 ±2 vdc negative return to connector contacts J1-B, J1-D, and J1-K | | |
| | FAC | c. Mainstage signal, when required, 28 ±2 vdc positive voltage to connector contact J1-E | | |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-16. Calibrating Gas Generator High-Low Temperature Cutoff Panel (Sheet 1 of 9)

| Step | LOC[a] | Operation | LOC[a] | Result |
|---|---|---|---|---|
| | FAC | d. Remote reset signal, when required, 28 ±2 vdc positive voltage to connector contact J1-C | | |
| 2 | | Prepare facility to receive the following signals: | | |
| | FAC | a. CUTOFF signal, 28 ±2 vdc positive voltage from connector contact J1-T, to facility engine cutoff circuitry | | |
| | FAC | b. Gas generator equivalent temperature voltage (zero to 0.27 vdc) from connector contacts J1-L (positive) and J1-M (negative) to facility temperature recorder | | |
| | | c. Signals to facility pen recorder (28 ±2 vdc, positive) from connector contacts as follows.<br>(1) Mainstage, J1-F<br>(2) Timer Z2, J1-G<br>(3) Power on, J1-J<br>(4) Timer Z3, J1-N<br>(5) Cutoff (relay energized), J1-P<br>(6) Cutoff (relay de-energized), J1-S | | |
| 3 | | (Deleted) | | |
| 4 | PAN | a. Make sure 28 VDC circuit breaker is in pushed-in position. | | |
| | PAN | b. Momentarily depress LAMP TEST switch. | PAN | DC POWER ON and CUTOFF lights come on momentarily. |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-16. Calibrating Gas Generator High-Low Temperature Cutoff Panel (Sheet 2 of 9)

| Step | LOC(a) | Operation | LOC(a) | Result |
|---|---|---|---|---|
| | PAN | c. Move DC POWER switch(a) to ON position. | PAN | DC POWER ON light comes on. |
| | PAN | d. Allow panel to warm up for approximately 15 minutes. | | |
| 5 | EQP | a. Replace engine gas generator thermocouple with a test thermocouple. | | |
| | EQP | b. Immerse test thermocouple in ice water bath (to provide zero-voltage reference). | FAC | Temperature monitor recorder indicates near zero. |
| | PAN | c. If necessary, turn adjustment ZERO ADJUST (on top of amplifier Z1) to obtain result. | FAC | Temperature monitor recorder indicates as near zero as possible. |
| | EQP | d. Remove test thermocouple. | | |
| 6 | EQP | a. Prepare VTVM by adjusting it to null at zero voltage. | | |
| | PAN | b. Connect positive lead of VTVM to test jack TP3 (or to terminal post TB3-1). | | |
| | PAN | c. Connect negative lead of VTVM to test jack TP4 (or to terminal post TB2-4). | | |
| 7 | EQP | a. Prepare calibration test equipment as shown in figure 2-10. | | |
| | FAC | b. Connect calibration test equipment as follows: (1) Positive lead to chromel wire (2) Negative lead to alumel wire | | |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-16. Calibrating Gas Generator High-Low Temperature Cutoff Panel (Sheet 3 of 9)

| Step | LOC[(a)] | Operation | LOC[(a)] | Result |
|---|---|---|---|---|
| | | (Leads may be connected to test jacks TP2 (+) and TP1 (-); however, best results are obtained when calibration test equipment is connected at engine end of thermocouple circuit. (See figure 2-10.) | | |
| 8 | EQP | a. Adjust calibration test equipment to provide result. (Adjust coarse and fine adjustments (potentiometers), and adjust potentiometer galvanometer to null at required voltage.) (In order to preserve batteries, switch S1 (figure 2-10) should be in a closed position only as necessary to accomplish test.) | EQP | 0.03507 ±0.00010 vdc to panel |
| | EQP, PAN | b. Make sure VTVM indicates required result. Turn adjustment GAIN ADJUST on top of amplifier Z1 as necessary. | EQP | 21.042 ±0.100 vdc (Gain ratio (step b : step a) is 600:1.) |
| 9 | EQP | a. Adjust calibration test equipment to provide result. | EQP | 0.01753 to 0.01778 vdc |
| | PAN | b. Press and hold CAL TEST switch. (Disregard CUTOFF light if it comes on.) | | |
| | | c. Wait 8 seconds (or until timer Z3 expires). (Refer to step 2, substep c.) | | |
| | EQP | d. Interrupt voltage provided by calibration test equipment. (Open switch S1, figure 2-10, or disconnect one lead.) | | |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-16. Calibrating Gas Generator High-Low Temperature Cutoff Panel (Sheet 4 of 9)

| Step | LOC[a] | Operation | LOC[a] | Result |
|---|---|---|---|---|
| | EQP (PAN) | e. Observe VTVM for required result. (If result is not as required, turn adjustment screw on end of variable resistor R11 as necessary to obtain result.) | EQP<br><br>EQP | (1) 10.00 to 11.04 vdc<br><br>(2) Voltage equivalent to temperature specified in R-3825-1B (See figure 2-15.) |
| | PAN | f. Release CAL TEST switch. | | |
| | EQP | g. Reconnect lead to calibration test equipment if disconnected in step d. | | |
| | EQP | h. Remove VTVM leads from panel. (Refer to step 7.) | | |
| 10 | EQP | a. Adjust calibration test equipment to provide result. | EQP | 0.00200 vdc (maximum) |
| | FAC | b. Actuate facility equipment as follows: | | |
| | | (1) Pen recorder to FAST ON (approximately 3 inches per second). | | |
| | | (2) Provide mainstage signal. (Refer to step 1, substep c.) | FAC | Pen recorder pen connected to connector contact J1-F becomes energized. |
| | | (3) Provide remote reset signal momentarily. (Refer to step 1, substep d.) | PAN, FAC | DC POWER ON light goes off momentarily. Recorder pens connected to connector contacts J1-J and J1-F become de-energized momentarily. |
| | FAC | c. After 8 seconds (minimum), deactuate facility equipment actuated in step b. | | |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-16. Calibrating Gas Generator High-Low Temperature Cutoff Panel (Sheet 5 of 9)

| Step | LOC[a] | Operation | LOC[a] | Result |
|---|---|---|---|---|
| | FAC | d. Review pen recorder chart paper for result. (Pens are connected to panel connector contacts as noted in result.) | FAC | (1) DC POWER ON signal J1-J) recorded. |
| | | | FAC | (2) Mainstage signal (J1-F) recorded. |
| | | | FAC | (3) Remote reset circuit operation recorded. (Pens connected to J1-F and J1-J indicate an interruption as required in step b, substep (3).) |
| | | | FAC | (4) Expiration signals of timers Z2 (J1-G and Z3 (J1-N) recorded[a]. |
| | | | FAC | (5) Cutoff relay circuit operation recorded. (Pen connected to J1-P becomes energized as pen connected to J1-S becomes de-energized.) |
| | FAC (PAN) | e. Measure time elapsed, on pen recorder chart paper, between mainstage signal (pen connected to connector contact J1-F, energized after remote reset operation of step b) and expiration signals of timers Z2 and Z3 (pens connected to connector contacts J1-G and J1-N). If results are not as required, open access cover and turn adjustment Z2 or Z3[a] as necessary (releasing and securing potentiometer shaft locks, if installed); then repeat applicable steps of step 10.) (CAL TEST switch may be used in lieu of a mainstage signal.) | FAC | (1) Elapsed time for timer Z2 (J1-G) must be time specified in R-3825-1B, or as desired. |
| | | | FAC | (2) Elapsed time for timer Z3 (J1-N) must be time specified in R-3825-1B, or as desired. |
| 11 | EQP | a. Make sure calibration test equipment provides result. | EQP | 0.0020 vdc (maximum) |
| | PAN | b. Press and hold CAL TEST switch[a]. | PAN | CUTOFF light comes on within one second. |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-16. Calibrating Gas Generator High-Low Temperature Cutoff Panel (Sheet 6 of 9)

| Step | LOC[a] | Operation | LOC[a] | Result |
|---|---|---|---|---|
| | EQP, PAN | c. Slowly adjust calibration test equipment to increase voltage provided until CUT-OFF light goes off. (If required result is not obtained, perform steps d and e.) | | Voltage provided must be the equivalent of temperature specified in R-3825-1B for low-temperature limit switch Z4[a]. (See figure 2-15.) |
| | PAN | d. Release CAL TEST switch. | | |
| | PAN | e. If result of step c is not as specified, open access cover and turn adjustment Z4 as necessary (releasing and securing potentiometer shaft locks, if installed); then repeat step 11. | | |
| 12 | EQP | a. Adjust calibration test equipment to provide result. | EQP | 0.01050 ±0.00010 vdc |
| | PAN | b. Press and hold CAL TEST switch[a]. | PAN | No visible result |
| | | c. Wait one second (minimum). | PAN | No visible result |
| | PAN | d. Release CAL TEST switch. | PAN | No visible result |
| | PAN | e. If results of steps a through d are not as required (CUTOFF light comes on), low-temperature limit switch Z4 is malfunctioning. Reject panel. | | |
| 13 | EQP | a. Adjust calibration test equipment to provide result. | EQP | 0.02700 ±0.00010 vdc |
| | PAN | b. Press and hold CAL TEST switch[a]. | | |
| | | c. Wait 8 seconds (minimum). | | |
| | EQP, PAN | d. Slowly adjust calibration test equipment to increase voltage provided until CUT-OFF light comes on. (If required result is not obtained, perform steps e and f.) | EQP | Voltage provided must be the equivalent of temperature specified in R-3825-1B for medium-temperature limit switch Z5[a]. (See figure 2-15.) |
| | PAN | e. Release CAL TEST switch. | | |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-16. Calibrating Gas Generator High-Low Temperature Cutoff Panel (Sheet 7 of 9)

| Step | LOC(a) | Operation | LOC(a) | Result |
|---|---|---|---|---|
| | PAN | f. If result of step d is not as specified, open access cover and turn adjustment Z5 as necessary (releasing and securing potentiometer shaft lock, if installed); then repeat steps 11 and 13. | | |
| 14 | FAC, PAN | Observe temperature monitor recorder and, if necessary, turn adjustment R10 to obtain result. | FAC | Temperature monitor recorder indicates temperature required in step 13, substep d. |
| 15 | | Check thermocouple safety circuit of panel as follows: | | |
| | PAN | a. Press and hold CAL TEST switch. | | |
| | | b. Wait 8 seconds (or until timer Z3 expires). | | |
| | EQP | c. Momentarily interrupt voltage provided by calibration test equipment. (Momentarily open switch S1, figure 2-10, or temporarily disconnect one lead.) | PAN | No visible result |
| | PAN | d. Release CAL TEST switch. | PAN | No visible result |
| | PAN | e. Press and hold CAL TEST switch. | | |
| | PAN (EQP) | f. Wait until timer Z3 expires, but perform next step before timer Z3 expires. (Observe recorder pens connected to connector contacts J1-G (timer Z2) and J1-N (timer Z3).) | | |
| | EQP | g. Momentarily interrupt voltage provided by calibration test equipment. (See step c.) | PAN | (1) No visible result on panel incorporating MD4 change. |
| | | | PAN | (2) CUTOFF light comes on (and remains on) on panel not incorporating MD4 change. |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-16. Calibrating Gas Generator High-Low Temperature Cutoff Panel (Sheet 8 of 9)

| Step | LOC[a] | Operation | LOC[a] | Result |
|---|---|---|---|---|
| | PAN | h. Release CAL TEST switch. | PAN | (1) No visible result on panel incorporating MD4 change. |
| | | | PAN | (2) CUTOFF light goes off on panel not incorporating MD4 change. |
| 16 | EQP | a. Adjust calibration test equipment to provide result. | | Voltage must be the equivalent of 200° F below temperature specified in R-3825-1B for high-temperature limit switch Z6[a]. (See figure 2-15.) |
| | PAN | b. Press and hold CAL TEST switch[a]. | | |
| | (EQP) | c. Wait until expiration of timer Z2. (Observe recorder pen connected to connector contact J1-G.) | | |
| | EQP | d. Slowly adjust calibration test equipment, to increase voltage provided, until result occurs. | PAN | CUTOFF light comes on. |
| | PAN | e. Release CAL TEST switch. | PAN | CUTOFF light goes off. |
| | PAN, EQP (FAC) | f. Repeat steps b through d until CUTOFF light comes on, before expiration of timer Z3. (Pen connected to J1-N.) | EQP | Voltage provided by calibration test equipment must be the equivalent of temperature specified in R-3325-1B, for high-temperature limit switch Z6. |
| | PAN | g. If result of step f is not as specified, open access cover and turn adjustment Z6[a] as necessary (releasing and securing potentiometer shaft lock, if installed); then repeat steps 11, 13, and 16. | | |
| 17 | PAN | a. Move DC POWER switch[a] to OFF position, if applicable. | | |
| | PAN | b. Close and seal access cover, if applicable. | | |
| | EQP | c. Deenergize and disconnect calibration test equipment. | | |
| | FAC | d. Reconnect engine gas generator thermocouple, if applicable. | | |
| | FAC | e. Deenergize applicable facility equipment, if applicable. | | |

(a) See figure 2-11 for abbreviations and nomenclature.

Figure 2-16. Calibrating Gas Generator High-Low Temperature Cutoff Panel (Sheet 9 of 9)

# SECTION III

# OUTBOARD ENGINE RESTRAINER G4066

WARNING

OUTBOARD ENGINE RESTRAINER G4066 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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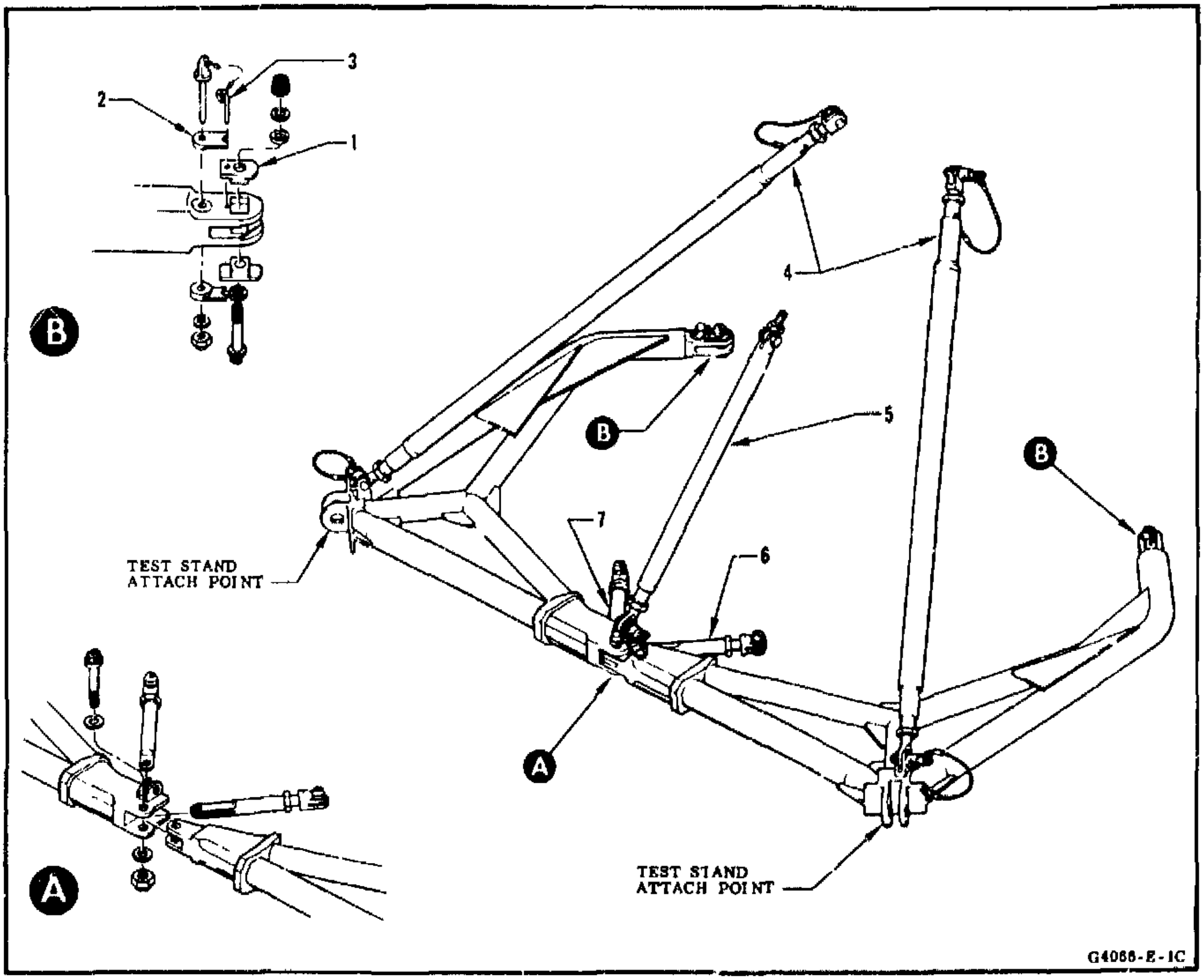
## 3-1. DESCRIPTION AND LEADING PARTICULARS OF OUTBOARD ENGINE RESTRAINER.

3-2. The outboard engine restrainer (figure 3-1) is used during engine static-tests to prevent thrust chamber damage due to uncontrolled fluctuations resulting from combustion irregularities during initial engine operation. The restrainer is installed between the facility test stand and the side of the thrust chamber. The restrainer consists of a tubular frame, adjustable struts, and attaching hardware. The restrainer frame is made up of two symmetrical frames attached at a pivot point and forming a C-shaped frame. The frame incorporates alinement marks and all openings to interior surfaces are sealed to prevent the entrance of moisture. Two slides and a centering pin arrangement are incorporated at both thrust chamber attach points of the restrainer frame to assist in installation and provide adjustment. Two clevises are provided on the restrainer frame for test stand attachment. There are five adjustable struts on the restrainer to provide additional support to the thrust chamber and to aid in adjusting the restrainer on the thrust chamber. The outboard engine restrainer is 80 inches long, 50 inches wide, and weighs 242 pounds. Instructions for the use of the restrainer are in R-3825-1 and R-3825-3.




| Index Number | Nomenclature |
|---|---|
| | Outboard Engine Restrainer G4066 |
| 1 | Slide (Typical) |
| 2 | Keeper |
| 3 | Shear Pin |
| | Details |
| 4 | Long Strut |
| | Rod End |
| | Clevis |
| 5 | Center Strut |
| | Rod Er l |
| 6 | Short Strut |
| 7 | Short Strut |
| | Clevis |

Figure 3-1. Outboard Engine Restrainer

3-2A. CONFIGURATION CHANGE--MANUAL EFFECTIVITY.

3-2B. The modification incorporated changing configuration of the outboard engine restrainer is listed in figure 3-1A.

| Approved ECP No. | MD No. | Incorporated in Manual Dated |
|---|---|---|
| J2-356 | 1 | 30 July 1965 |

Figure 3-1A. Configuration Change--Manual Effectivity

3-3. MAINTENANCE OF OUTBOARD ENGINE RESTRAINER.

3-4. Maintenance requirements are listed in figure 3-2. Information presented lists the tasks to be performed, when the tasks must be performed, and reference to data necessary to accomplish these tasks. When replacing parts, see figure 3-1 to locate replaceable parts and attaching hardware. Refer to R-5101, J-2 Rocket Engine Maintenance Plan, for ground support equipment repair schedule. Torque nut MS20500-1414 to 575 ±25 inch-pounds when assembling restrainer.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect restrainer for completeness. | X | X | | | See figure 3-1. Replace missing part. |
| Inspect restrainer frames for: | | | | | Remove and replace. Refer to paragraph 3-3. |
| Dents. | X | X | | | |
| Structural deformation. | | X | | | |
| Bent test stand attach clevises. | X | X | | | |
| Misalined holes on test stand attach clevises. | | X | | | |
| Evidence of internal corrosion at plug screws and long strut clevis attach points. | | X | | | |

Figure 3-2. Maintenance Requirements (Sheet 1 of 2)

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Cracks at weld joints. | | | | X | Dye-penetrant inspect (RA0115-116, Type II), using Turco Dy-Chek Kit No. 25 (Turco Products), or equivalent, every 30 engine starts (maximum) with restrainer removed from engine. If inspection indicates cracks, notify Rocketdyne Field Engineering Representative for disposition. |
| Dry-film lubrication worn from mating surfaces of frames and short struts. | | | | X | Prior to assembly. Remove and replace. Refer to paragraph 3-3. |
| Rubber compound which seals internal surfaces for deterioration, and separation of bond to metal surfaces. | | X | X | X | Every six months (once a year if in storage). If seal is defective, repair or replace the seal. Refer to paragraph 3-11. |
| Inspect slides for restricted movement. | | X | | | Remove and replace. Refer to paragraph 3-3. |
| Inspect for bent or sheared centering pins. | X | X | | | Remove and replace. Refer to paragraph 3-3. |
| Inspect strut rod end bearings for restricted movement. | X | X | | | Remove and replace. Refer to paragraph 3-3. |
| Inspect for bent struts. | X | X | | | Remove and replace. Refer to paragraph 3-3. |
| Clean. | | | | X | As required. Refer to paragraph 3-5. |

Figure 3-2. Maintenance Requirements (Sheet 2 of 2)

3-5. CLEANING OUTBOARD ENGINE RESTRAINER.

3-6. Clean restrainer with any suitable acid-free solvent or detergent. Hand-wiping or steam cleaning method may be employed. Care should be exercised to prevent moisture or cleaning agent from entering the rod-end bearings.

3-7. PREPARING OUTBOARD ENGINE RESTRAINER FOR STORAGE OR SHIPMENT.

3-8. Prepare restrainer for storage or shipment by cleaning and inspecting restrainer. (Refer to paragraphs 3-3 and 3-5.) Secure the unattached ends of the struts to the frame with cloth tape and pad areas that contact the frame.

3-9. MAINTENANCE OF OUTBOARD ENGINE RESTRAINER COMPONENTS.

3-10. Repair of restrainer components is limited to replacing defective parts. Refer to R-5101, J-2 Rocket Engine Maintenance Plan, for ground support equipment repair schedule. No rework (bending, straightening, patching, fitting) is permissible on any restrainer component. Frames which utilize a rubber compound to seal openings may be repaired as outlined in paragraph 3-11.

3-11. REPAIRING FRAMES.

3-12. Frames used in restrainer incorporating rubber compound to environmentally seal the interior surfaces may be repaired as outlined in this procedure by replacing sealant material which has deteriorated or separated from the metal surfaces. Frames repaired by this procedure may be used 24 hours after effecting the repair if the sealant material is cured by the ambient method, three hours if the material is cured at the elevated temperature noted in the procedure.

a. Obtain the following materials:

(1) Primer PR-1531 and potting compound PR-1532 (Products Research and Chemical Co).

(2) Commercial grade acetone or trichloroethylene.

b. Remove as much of the existing sealant material as possible; complete removal is not necessary. Sealant which is firmly bonded to the metal and is not deteriorated need not be removed since the replacement sealant will bond to it.

c. If effecting a repair at the test stand attach fittings, remove the metal shim which is part of the seal.

d. Through the openings created by removal of shim and/or sealant material, inspect the interior surfaces of the frame for evidence of rust. Replace frame if rust is present.

WARNING

The following procedure specifies acetone, which is flammable and must not be used near heat, sparks, or open flame. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury.

- The following procedure specifies trichloroethylene, which is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

e. Thoroughly clean all surfaces to which the sealant is to be applied with a clean rag dampened with acetone or trichloroethylene. The solvent must completely evaporate from the cleaned surfaces before proceeding with the next step.

WARNING

The following specifies primer PR-1513, which is flammable and must not be used near heat, sparks, or open flame. It is toxic. Inhalation of its vapors or prolonged contact with the primer can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

f. Thoroughly shake the primer and then apply it to the cleaned surfaces with a soft bristled brush. Apply one thin continuous coat and allow it to dry at ambient temperature for a minimum of 40 minutes. Primed surfaces must have the sealant applied within 24 hours of priming.

WARNING

The following specifies potting compound PR-1532, which is toxic. Inhalation of its vapors or contact with the material can cause serious bodily harm. It must be used in a well-ventilated area. In case of contact, wash skin with soap and water.

g. Thoroughly mix the two parts of the potting compound in the proportions recommended by the manufacturer. The compound is usable (pot life) for 4 hours after mixing.

WARNING

The following procedure specifies acetone, which is flammable and must not be used near heat, sparks, or open flame. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury.

- The following procedure specifies trichloroethylene, which is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

h. Apply compound to the primed areas with a spatula or sealant gun. Before curing, compound may be removed from adjacent surfaces and equipment with a clean rag dampened with acetone or trichloroethylene.

i. Cure the potting compound. The compound will cure fully in 8 days at ambient temperature or in 16 hours at 120° F. The cured compound must not be tacky. If tacky, additional curing time or heat may cure the material. If additional time or heat is not effective, the compound must be replaced. All uncured material must be removed before new material is applied.

# SECTION IV

# FILM-COOLED DIFFUSER G4070

WARNING

FILM-COOLED DIFFUSER G4070 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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## 4-1. DESCRIPTION AND LEADING PARTICULARS OF FILM-COOLED DIFFUSER.

4-2. The film-cooled diffuser (figure 4-1) effects simulation of high altitude performance of the rocket engine by reducing the nozzle expansion ratio from 27.2:1 to 25.3:1. Reducing the nozzle expansion ratio increases the wall pressure at the exit of the nozzle, causing the nozzle to flow fully at low chamber pressure levels, where nozzle separation normally occurs.

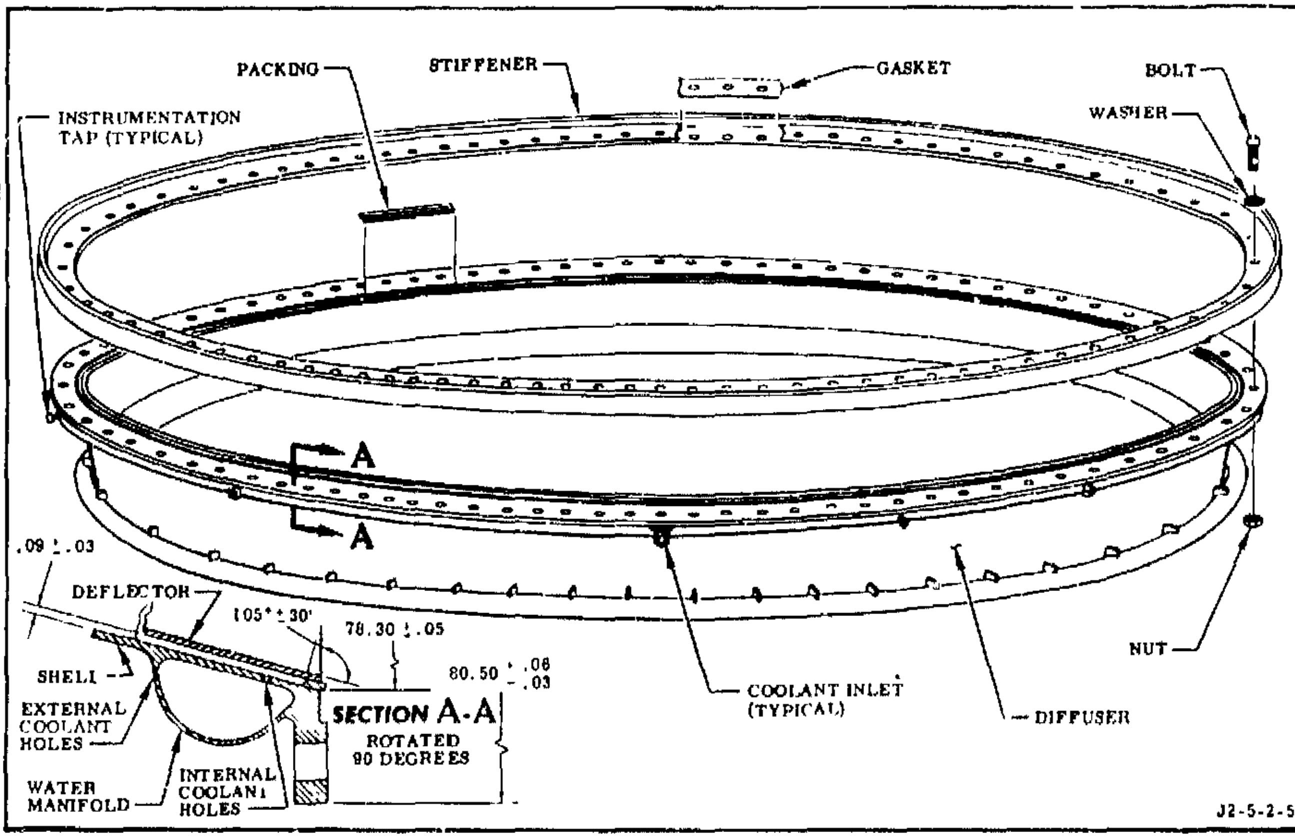



Figure 4-1. Film-Cooled Diffuser

4-3. The film-cooled diffuser consists of a diffuser, a stiffener, gasket, packings, and the hardware necessary to attach it to the thrust chamber of the rocket engine. The diffuser and stiffener are welded assemblies.

4-4. To protect the diffuser from the high heat of the exhaust gases, a water manifold which contains 500 coolant holes is incorporated. Half of the coolant holes apply water to the inner surface, the remaining half apply water to the outer surfaces of the diffuser. During engine test, water under pressure is supplied to the manifold, and through the coolant holes is distributed in a uniform film over the diffuser, effectively protecting it from the heat of the exhaust gases. Leading particulars for the film-cooled diffuser are given in figure 4-2. Instructions for the use of the film-cooled diffuser are in R-3825-1B.

| | |
|---|---|
| Height | |
| Diffuser | 5.00 inches |
| Stiffener | 1.50 inches |
| Diameter | |
| Diffuser | 80.50 inches |
| Stiffener | 81.45 inches |
| Weight | |
| Diffuser | 77.4 pounds |
| Stiffener | 74.5 pounds |
| Handling Provisions | |
| Diffuser | Three equally spaced lugs, welded to external surface. Lugs have 3/8 inch holes. |
| Instrumentation Taps | |
| Diffuser | Three equally spaced bosses, machined per AND10050-4. |
| Coolant Inlets | |
| Diffuser | Two equally spaced bosses, machined per AND10050-16. |

Figure 4-2. Leading Particulars for Film-Cooled Diffuser

4-4A. CONFIGURATION CHANGE - MANUAL EFFECTIVITY.

4-4B. The modification incorporated changing configuration of the film-cooled diffuser is listed in figure 4-2A.

| Approved ECP No. | MD No. | Incorporated In Manual Dated |
|---|---|---|
| J2-392 | 1 | 30 July 1965 |

Figure 4-2A. Configuration Change - Manual Effectivity

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect for completeness | X | X | | | Complete film-cooled diffuser consists of all items shown in figure 4-1. Two packings and 3 graphs are required. |
| Inspect for damage | X | X | | | Refer to paragraph 4-7. |
| Test | | X | | | Refer to paragraph 4-15. |
| Drain and purge | | | | X | After use. Refer to paragraph 4-17. |

Figure 4-3. Maintenance Requirements for Film-Cooled Diffuser

4-5. MAINTENANCE OF FILM-COOLED DIFFUSER.

4-6. A minimum of maintenance is required for the film-cooled diffuser. See figure 4-3 for required maintenance tasks. This figure lists the required tasks that must be performed at specific intervals, when these tasks are to be performed, and a reference to the data necessary to accomplish these tasks. No special procedures are required to ship or store the film-cooled diffuser, however if handling containers RX-23290 and RK394-10138 are available, it is preferable to ship or store the diffuser and stiffener respectively in these containers.

4-7. INSPECTING FILM-COOLED DIFFUSER FOR DAMAGE.

4-8. Inspect the film-cooled diffuser for damage caused by mishandling and burning. Damage which does not impair the film-cooled diffuser capability to perform its function may be considered acceptable. When inspecting the film-cooled diffuser for damage, pay particular attention to the following:

a. Distortion or surface damage to sealing surfaces.

b. Required clearance between shell and deflector. (See figure 4-1.)

c. Weld securing deflector to shell for cracks. (See figure 4-1.)

d. Dents on water manifold that will limit water flow to below acceptable limits.

e. Indications of overheating that have resulted in eroded or burned through areas. Discoloration due to heat is acceptable.

f. Restricted or plugged coolant holes. Internal coolant holes can be checked by either the use of a probe or by observing that a continuous uniform film of water is applied to the inner surfaces of the diffuser when the diffuser is tested. Refer to paragraph 4-15.

4-9. CLEANING FILM-COOLED DIFFUSER.

4-10. The only required cleaning is to remove foreign material which is restricting or plugging the coolant holes. (See figure 4-1.) Plugged or restricted coolant holes may be cleared with the use of a probe. The probe should be slightly smaller in diameter than the 0.038-inch coolant hole; improved diffusers incorporate 0.041-inch coolant holes. To determine if holes are clean, test diffuser. Refer to paragraph 4-15.

4-11. REPAIRING FILM-COOLED DIFFUSER.

4-12. Damage to the film-cooled diffuser assembly is anticipated to be limited to painted surfaces, cracked welds, distortion, and erosion or burning of the diffuser (6, figure 4-1). Make repair by touching up or repainting, straightening, and welding the diffuser as required.

4-13. PAINTING. Touch up or repaint stenciled markings or painted surfaces as necessary. To match the original lacquer, use the following colors as noted: Original lacquer used on the film-cooled diffuser conforms to Federal Specification TT-L-32.

a. Stenciled markings on stiffener (figure 4-1), black, number 17038 (Federal Standard 595).

b. Stenciled markings on diffuser (figure 4-1), black, number 37038 (Federal Standard 595).

c. Painted surfaces of stiffener, red, number 31136 (Federal Standard 595).

4-14. WELDING. Cracked welds of the diffuser may be repaired by grinding out the defect and rewelding. Burned through areas may be repaired by either building them up with weld or replacing them with a new section. Within the following limits, repairs are permitted on any part of the diffuser.

a. Replacement material shall be 347 CRES and of the same gage as the original.

b. Repair must be accomplished without blocking or impairing the function of the internal or external coolant holes.

c. Repair shall not result in distortion which affects the mating or sealing of the diffuser to the stiffener (figure 4-1), or adversely affect dimensions shown in figure 4-1.

d. Welds on the shell or deflector must be flush on both inside and outside surfaces. Flush welds prevent inpingement of hot engine gases on a localized area and a disruption in the water film necessary to protect the diffuser. Welds may be ground flush.

e. Repaired areas are to be checked for cracks by the dye penetrant method.

4-14A. STRAIGHTENING. Distortion of the film-cooled diffuser may be corrected by straightening the defective area as necessary. Limitations to the methods employed (twisting, prying, hammering with soft mallet) to straighten a distorted film-cooled diffuser are governed only by the resultant reworked unit. Straightened film-cooled diffusers shall comply with dimensions shown in figure 4-1 and tested in accordance with paragraph 4-15.

4-15. TESTING FILM-COOLED DIFFUSER.

4-16. Testing the film-cooled diffuser consists of applying water under pressure to the diffuser and measuring the quantity and uniformity of the flow. To test the diffuser, proceed as follows:

NOTE

To prevent restricting the coolant holes, it is recommended that water used in this test be filtered with a 70 micron or finer filter.

- Any test equipment capable of measuring water flow in the range of 18 to 25 lbs/sec and pressure of 80 PSIG may be used for testing the diffuser. Accuracy of the test equipment shall be within two percent of the measured value.

a. Apply water under pressure to both coolant inlets. (See figure 4-1.) Water pressure shall be sufficient to maintain 80 psig at instrumentation tap located approximately 90° from coolant inlets.

b. Diffuser shall flow a minimum of 20 lbs/sec of water. Water flow shall be uniform over inside lower surface of diffuser and all external coolant holes shall be open and flowing.

c. Clean obstructions from coolant holes if flow does not meet minimum requirements, is not uniform over internal surface, or if external coolant holes are not open and flowing. Refer to paragraph 4-9 for cleaning diffuser.

## 4-17. DRAINING AND PURGING FILM-COOLED DIFFUSER.

4-18. To aid in preventing an accumulation of deposits which can obstruct the coolant holes, it is recommended that the diffuser be drained and purged of water. Drain all water from the diffuser and then apply a gaseous purge to remove remaining moisture.

# SECTION V

## COMPONENTS ADAPTER SET 9016796

WARNING

COMPONENTS ADAPTER SET 9016796 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

TABLE OF CONTENTS



5-1. DESCRIPTION AND LEADING PARTICULARS OF COMPONENTS ADAPTER SET.

5-2. The components adapter set consists of test equipment, test kits, test accessories, and a storage cabinet and is used to support and provide additional test capabilities for Components Test Console G3107. (Refer to R-3825-5, Volume I.) Figure 5-1 lists the major units of equipment, the adapter sets, and the delivered quantity of the various accessories. Paragraphs 5-3 through 5-6 describe the test equipment. Instructions for the use of the components adapter set are in R-3825-3.

5-3. LEAK DETECTOR SET. The leak detector set includes a leak detector unit, a test port station, two movable work stands, an auxiliary vacuum pump, operation and maintenance manuals, and specialized test and calibration equipment. See figure 5-2 for leading particulars. The leak detector unit is a simplified, specialized mass spectrometer and utilizes a combination

| Part Number | Equipment | Accessories[a] |
|---|---|---|
| 24-120B[d] | Leak detector | Accumulator (4) |
| 24-014A[d] | Sampling probe kit | Adapter (6) |
| 25643-1[e][f] | Standard leak | Bag (6) |
| 60686[d] | Bell jar | Burst diaphragm (50) |
| 138920[d] | Bell jar baseplate | Bushing (21) |
| 992231-0008[e] | Operation and Maintenance Manual (24-120B) | Cable (12) |
| 34620-2184[e] | Operation and Maintenance Manual (24-120A) | Cap (104) |
| 24-025A[d] | Test port station | Coupling (2) |
| 34620-2165[e][g] | Operation and Maintenance Manual (24-025A) | Clamp (2) |
| 24-035[d] | Workstand (2) | Connection valve (1) |
| 133648-1[d] | Auxiliary vacuum pump | Cross (27) |
| 1052[h] | Flowrate tester and stopwatch | Cryogenic hand valve (2) |
| NA5-24039 | Portable environmental test chamber | Elbow (24) |
| 122-2.5[i] | High-voltage leakage tester | Filter (4) |
| 19-9018996-1 | Cabinet | Hand valve (3) |
| | **Adapter Sets** | Hose (40) |
| | | Manifold (1) |
| 9921780-11 | Fuel turbopump | Nut (22) |
| 9021876 | Heat exchanger | Orifice (1) |
| 9021887 | Fuel jacket purge check valve | Packing (372) |
| 9021901 | Spark igniter (dielectric test) | Patch-cord (7) |
| 9022429 | Start tank | Plug (62) |
| 9022447-11 | Bleed valve | Reducer (58) |
| 9022529 | Tank support-and-fill valve | Restrictor (4) |
| 9022548 | Three-way solenoid valve | Ring (96) |
| 9022554 | Heat exchanger antiflood check valve | Tee (28) |
| 9022558 | Oxidizer check valve | Temperature transducer (1) |
| 9022596 | Augmented spark igniter | Tube (38) |
| 9022690 | Helium high-pressure relief valve | Union (89) |
| 9022693[b] | Oxidizer turbopump | Universal test lead (1) |
| 9022693-11[c] | Oxidizer turbopump | Vise (1) |
| 9022726 | Fuel bleed valve | |
| 9022732 | Oxidizer bleed valve | |
| 9022736 | Main oxidizer valve | |
| 9022750-11 | Start tank discharge valve | |
| 9022751 | Four-way control valve | |
| 9022755 | Main fuel valve | |
| 9022759-11 | Oxidizer turbine bypass valve | |
| 9022773 | Gas generator control valve | |
| 9022776 | Helium regulator | |
| 9022782 | Augmented spark igniter valve | |
| 9022783 | Propellant utilization valve | |
| 9022784 | Vent-and-relief valve | |
| 9022786 | Spark igniter | |
| 9022800 | Sequence control valve | |

(a) Numbers in parentheses indicate the delivered quantity.
(b) In components adapter set 9016796-61.
(c) In components adapter set 9016796-71.
(d) Du Pont.
(e) Bell & Howell Co.
(f) Replace with metal helium standard leak 141430-8 (Du Pont).
(g) Replace with service manual 992165 (Du Pont).
(h) Brooks Instrument Co.
(i) Slaughter Co.

Figure 5-1. Components Adapter Set 9016796

NOTE

All part numbers are Du Pont.

LEAK DETECTOR 24-120B OR 24-120A (ALLOWABLE ALTERNATE)

| | |
|---|---|
| Width | 30 inches |
| Height | 22 inches |
| Depth | 20 inches |
| Weight | 200 pounds |
| Power requirements | 115 volts (±10%)<br>60 cps<br>7 amps |
| Operating clearance (minimum) | one foot from wall |

TEST PORT STATION 24-025A

| | |
|---|---|
| Width | 30 inches |
| Height | 7-1/2 inches |
| Depth | 20 inches |
| Weight | 75 pounds |
| Power requirements | 110 volts<br>60 cps<br>one amp |

AUXILIARY VACUUM PUMP 133648-1

| | |
|---|---|
| Vacuum rating | 14 cfm |
| Power requirements | 110 vac |

Figure 5-2. Leading Particulars for Leak Detector Set

of vacuum, cryogenic, and electronic techniques to detect very minute quantities of helium. A gaseous helium test sample enters the leak detector unit at very low pressure through a combination vacuum-operated, automatic, protection throttle valve; is directed through a liquid nitrogen encased cold trap; and exits through two vacuum pumps (diffuser pump and forepump) connected in series. A small portion of the test sample enters the analyzer section through a port in the cold trap. The cold trap captures the condensable vapors to prevent contamination from entering the analyzer section, and aids in the operation of the vacuum diffuser pump. In the analyzer (Diatron tube), gas molecules are ionized by an electron flow from the Diatron filament and accelerated into a magnetic field where they separate due to difference in mass. A target (collector plate) intercepts and counts only helium ions. The buildup of helium ions on the target generates a small current, which is amplified and indicated on a meter. Because the Diatron filament is exposed to the sample gases, a protective circuit is incorporated to turn off current to the filament whenever the gas pressure rises above a pressure of 0.2 microns of mercury. The automatic portion of the protection throttle valve is connected to the filament protection circuit to prevent pressure surging. When the test port station is connected, this circuit is disabled. The test port station simplifies certain operations of the leak detector and provides additional test capabilities. The auxiliary vacuum pump (roughing pump) is used to evacuate the test port station test setup before opening the test setup to the leak detector. A baseplate on top of the test port station permits various test setups, including the use of a bell jar. The sampling probe kit, consisting of a sample probe and a length of vinyl tubing (or vacuum quality rubber tubing suitable for helium leak detector use), is used for isolating leaks and may be connected directly to the leak detector unit. A calibrated standard leak is used to calibrate the leak detector. Detailed operation and maintenance instructions are in the Operation and Maintenance Manuals supplied with units of the leak detector set. Assembly and installation procedures are in paragraph 5-16.

5-4. FLOWRATE TESTER AND STOPWATCH. The flowrate tester and stopwatch 1052 (Brooks Instrument Co) is a positive displacement instrument used to accurately determine gas flowrates by vertical movement of a mercury sealed piston in a glass tube. Flowrate is determined by the amount of air displaced by piston movement divided by the time required for displacement. The tester scale is graduated from 0 to 30 cubic centimeters.

5-5. PORTABLE ENVIRONMENTAL TEST CHAMBER. Portable environmental test chamber NA5-24039 is placed in the test cell of the components test console for component cryogenic test. The component to be tested is placed in the test chamber, test connections are made, then the test chamber is filled with liquid nitrogen. The test chamber is an insulated container with a removable cover secured with 4 latches. Fourteen ports are provided on the test chamber, enabling tests to be performed with the test chamber cover installed. A vent hole and test lead access are located on the test chamber cover. A bracket is installed in the

test chamber for mounting filters used during component test. Liquid nitrogen fill-and-drain ports on the test chamber enable the test chamber to be filled from components test console supply.

5-6. HIGH-VOLTAGE LEAKAGE TESTER. High-voltage leakage tester 122-2.5 (Slaughter Co) is an electrical instrument supplying ac test voltage and is used for insulation resistance and high-voltage leakage tests on electrical systems of components being tested by the components test console. A voltmeter monitors test voltage, and a microammeter permits accurate determination of current flow into the component being tested. The tester is a portable unit mounted in a carrying case. A removable cover is attached to the case with four latches. The tester requires a 117-volt, 60-cycle power supply.

5-7. COMPONENTS ADAPTER SET TEST KITS. The test kits are comprised of adapter sets that are used to test engine components in conjunction with the components test console. Each adapter set contains test fixtures, seals, and attaching hardware. The adapter sets and contents are listed in figure 5-3.

| Part Number | Nomenclature | Quantity (One each except as noted) |
|---|---|---|
| 9021780-11 | Fuel turbopump adapter set | |
| 9021781 | Plate (manifold seal) | |
| 5-516-1011-10 | Packing | |
| RD111-1009-6421 | Bolt | 60 |
| RD153-5001-0004 | Washer | 60 |
| NAS679C4W | Nut | 60 |
| AN814-4C | Plug | |
| MS28778-4 | Packing | |
| 9021782 | Plate (volute half seal) | |
| MS28775-244 | Packing | |
| RD111-1009-6730 | Bolt | 16 |
| RD153-5001-0007 | Washer | 16 |
| NAS679C7W | Nut | 16 |
| AN814-4C | Plug | |
| MS28778-4 | Packing | |
| 9021783 | Plate (turbine manifold inlet seal) | |
| MS28775-228 | Packing | |
| RD111-1009-6617 | Bolt | 12 |
| RD153-5001-0006 | Washer | 12 |
| AN814-4C | Plug | |
| MS28778-4 | Packing | |
| 9021784 | Plate (gas generator combustor seal) | 12 |
| MS29513-259 | Packing | |
| RD111-1009-6517 | Bolt | 16 |
| RD153-5001-0005 | Washer | 16 |
| AN814-4C | Plug | |
| MS28778-4 | Packing | |
| 9021956 | Plate (inlet volute) | |
| MS29513-270 | Packing | |
| RD111-1009-6642 | Bolt | 24 |
| RD153-5001-0006 | Washer | 24 |
| NAS679C6W | Nut | 24 |
| AN814-4C | Plug | |
| MS28778-4 | Packing | |
| 9022688-5 | Tube | 6 |
| AN737TW22 | Clamp | 8 |
| AN807-4C | Adapter | 4 |
| AN929-4C | Cap | 4 |
| MS21919WDG-6 | Clamp | 2 |
| 9022688-9 | Tube | 2 |
| AN737TW30 | Clamp | 4 |
| AN807-8C | Adapter | 2 |
| AN929-8C | Cap | 2 |
| 9022699 | Plate (temperature transducer mounting) | 2 |
| MS28775-020 | Packing | 2 |
| RD111-1009-6414 | Bolt | 8 |
| RD153-5004-0004 | Washer | 8 |
| AN814-4C | Plug | 2 |
| MS28778-4 | Packing | 2 |

Figure 5-3. Components Adapter Set Test Kits (Sheet 1 of 10)

| Part Number | Nomenclature | Quantity (One each except as noted) |
|---|---|---|
| AN814-6C | Plug (gas generator combutor) | 2 |
| MS28778-6 | Packing (gas generator combustor) | 2 |
| AN814-4C | Plug (gas generator combustor) | 3 |
| MS28778-4 | Packing | 3 |
| AN814-2C | Plug (gas generator combustor) | 8 |
| MS28778-2 | Packing | 8 |
| AN814-2C | Plug (manifold exhaust duct seal bleed) | |
| MS28778-2 | Packing | |
| 701852 | Plug (gas generator combustor) | 8 |
| 404659 | Seal | 8 |
| 9021876 | Heat exchanger adapter set | |
| 9021877 | Plate (oxidizer outlet) | |
| MS29513-224 | Packing | |
| NAS1004-17A | Bolt | 8 |
| RD153-5004-0004 | Washer | 8 |
| RD153-1002-0004 | Washer | 8 |
| NAS679C4W | Nut | 8 |
| AN814-8C | Plug | |
| MS28778-8 | Packing | |
| 9021878 | Plate (bypass) | |
| MS29513-215 | Packing | |
| NAS1004-18A | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| RD153-1002-0004 | Washer | 4 |
| NAS679C4W | Nut | 4 |
| 9021879 | Plate (oxidizer inlet) | |
| MS29513-227 | Packing | |
| NAS1005-16A | Bolt | 6 |
| RD153-5004-0005 | Washer | 8 |
| RD153-1002-0005 | Washer | 6 |
| NAS679C5 | Nut | 6 |
| NAS1005-10A | Bolt | 2 |
| AN814-4C | Plug | |
| MS28778-4 | Packing | |
| 9021883 | Plate (accessory drive) | |
| MS29513-246 | Packing | |
| RD153-1002-0006 | Washer | 12 |
| NAS679C6 | Nut | 12 |
| 9021884 | Inlet plate | |
| 9021882 | Packing | |
| NAS1004-26A | Bolt | 36 |
| RD153-5004-0004 | Washer | 36 |
| RD153-1002-0004 | Washer | 36 |
| NAS679C4W | Nut | 36 |
| AN814-4C | Plug | |
| MS28778-4 | Packing | |
| 9021885 | Outlet plate | |
| MS9021-278 | Packing | |
| NAS1004-18A | Bolt | 20 |
| RD153-5004-0004 | Washer | 20 |
| RD153-1002-0004 | Washer | 20 |
| NAS679C4W | Nut | 20 |
| AN814-4C | Plug | |
| MS28778-4 | Packing | |
| 9021886-3 | Rod | 2 |
| 9021886-5 | Rod | 2 |
| MS20500-1216 | Nut | 12 |
| RD153-1002-0012 | Washer | 12 |
| 9022436 | Plate | 2 |
| AN6227 11 | Packing | 2 |
| NAS1004-8A | Bolt | 4 |
| NAS1004-9A | Bolt | 4 |
| RD153-5004-0004 | Washer | 8 |
| AN814-4C | Plug | 2 |
| MS28778-4 | Packing | 2 |
| AN814-2C | Plug | 7 |
| MS28778-2 | Packing | 5 |
| MS28778-2C | Packing | 2 |
| AN814-4C | Plug | |
| MS28778-4 | Packing | |
| 701853 | Plug | |
| 404659 | Seal | |

Figure 5-3 Components Adapter Set Test Kits (Sheet 2 of 10)

| Part Number | Nomenclature | Quantity (One each except as noted) |
|---|---|---|
| 9021887 | Fuel jacket purge check valve adapter set | |
| 9021888 | Plate | |
| RD261-3010-0014 | Seal | |
| | | |
| 9021889 | Plate (retainer) | |
| 9021890 | Fitting | |
| MS29513-111 | Packing | |
| MS28782-9 | Retainer | |
| RD111-1010-6441 | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| RD153-1002-0004 | Washer | 4 |
| NAS679C4W | Nut | 4 |
| | | |
| 9021901 | Spark igniter dielectric test adapter set | |
| 9021897 | Chamber | |
| 9021896 | Manifold | |
| AN833-4C | Elbow | 2 |
| AN6289C4 | Nut | 2 |
| MS9058-04 | Ring | 2 |
| MS28778-4 | Packing | 2 |
| 19-9021904-2 | Hose | 2 |
| | | |
| 9021899 | Shade | |
| XSTW-1000 | Window | |
| MS28778-12 | Packing | |
| | | |
| 9021900 | Adapter | |
| NAS1003-21A | Bolt | 2 |
| RD153-5004-0003 | Washer | 2 |
| MS15795-808 | Washer | 2 |
| AN345C10 | Nut | 2 |
| | | |
| 9021903 | Insulator | |
| 9021898 | Mat | |
| 5250-M11 | DC Hypot | |
| | | |
| 9022429 | Start tank adapter set | |
| 9022428 | Plate (helium port 1) | |
| RD111-4009-0528 | Bolt | 12 |
| RD153-5002-0005 | Washer | 12 |
| MS28775-140 | Packing | |
| | | |
| 9022435 | Plate (port 3) | |
| RD111-4009-0616 | Bolt | 12 |
| RD153-5002-000[illegible] | Washer | 12 |
| AN6227-34 | Packing | |
| | | |
| 9022436 | Plate | |
| RD111-4009-0410 | Bolt | 4 |
| RD153-5002-0004 | Washer | 4 |
| AN6227-11 | Packing | |
| | | |
| 9022438 | Plate (port 2) | |
| RD111-4009-0716 | Bolt | 12 |
| RD153-5002-0007 | Washer | 12 |
| AN6227-39 | Packing | |
| | | |
| 9022439 | Plate (port 4) | |
| RD111-4009-0618 | Bolt | 8 |
| RD153-5002-0006 | Washer | 8 |
| AN6227-34 | Packing | |
| | | |
| 9022446 | Support | |
| | | |
| 9022447-11 | Bleed valve adapter set | |
| 9021957 | Adapter (outlet and dual temperature probe po[illegible] | |
| RD261-3010-0012 | Seal | |
| NAS1004-16A | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| AN814-4C | Plug | |
| MS28778-4 | Packing | |
| | | |
| 9022534 | Plate (inlet) | |
| RD261-3010-0027 | Seal | |
| NAS1004-18A | Bolt | 8 |
| RD153-0010-0010 | Washer | 8 |
| LD153-0010-0010 | Washer | 8 |
| NAS679-C4W | Nut | 8 |
| AN814-4C | Plug | |
| MS28778-4 | Packing | |
| | | |
| 9022535 | Plate (bleed return) | |
| RD261-3010-0027 | Seal | |
| NAS1004-8A | Bolt | 6 |
| RD153-5004-0004 | Washer | 6 |
| AN814-4C | Plug | |
| MS28778-4 | Packing | |

Figure 5-3. Components Adapter Set Test Kits (Sheet 3 of 10)

| Part Number | Nomenclature | Quantity (One each except as noted) |
|---|---|---|
| 9022536 | Plate (open and close ports) | 3 |
| RD261-3010-0012 | Seal | 3 |
| NAS1004-10A | Bolt | 12 |
| RD153-5004-0004 | Washer | 12 |
| AN814-4C | Plug | 3 |
| MS28778-4 | Packing | 3 |
| AN814-2C | Plug | 2 |
| MS28778-2 | Packing | 2 |
| AN814-4C | Plug | |
| MS28778-4 | Packing | |
| 9022529 | Tank support-and-fill valve package adapter set | |
| 9020045-71 | Adapter | |
| 9020045-81 | Adapter | |
| 9022557 | Retainer | |
| NAS1004-3A | Bolt | 8 |
| RD153-5004-0004 | Washer | 8 |
| NAS1004-9A | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| 9022568 | Plate | |
| RD261-3010-0042 | Seal | |
| NAS1006-29A | Bolt | 12 |
| RD153-5004-0006 | Washer | 12 |
| NAS679C6W | Nut | 12 |
| MS15795-814 | Washer | 12 |
| 9022569 | Brace | 2 |
| 9022580 | Retainer | |
| 9022548 | Three-way solenoid valve adapter set | |
| 9022547 | Plate | |
| 12130CL16 | K-seal | |
| 12130CL8 | K-seal | 2 |
| RD111-1012-6424 | Bolt | 2 |
| RD153-5004-0004 | Washer | 2 |
| AN815-4C | Union | 3 |
| 9022554 | Heat exchanger antiflood check-valve adapter set | |
| 9022544 | Support plate assembly | |

| Part Number | Nomenclature | Quantity (One each except as noted) |
|---|---|---|
| NAS1004-1A | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| 9022545-3 | Bracket | |
| 9022545-5 | Bracket | |
| NAS1004-11A | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| NAS679C4W | Nut | 4 |
| MS15795-810 | Washer | 4 |
| 9020045-91 | Adapter | |
| 9022546 | Retainer | |
| NAS1004-22A | Bolt | 2 |
| RD153-5004-0004 | Washer | 2 |
| NAS679C4W | Nut | 2 |
| MS15795-810 | Washer | 2 |
| 9022466 | Check valve plate | |
| MS29513-023 | Packing | |
| NAS1004-8A | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| 9022549 | Cap | |
| AN6227-32 | Packing | |
| NAS1005-14A | Bolt | 6 |
| RD153-5004-0005 | Washer | 6 |
| NAS1005-21A | Bolt | 2 |
| RD153-5004-0005 | Washer | 2 |
| NAS679C5 | Nut | 2 |
| MS15795-812 | Washer | 2 |
| 9022551 | Angle | 2 |
| NAS1004-4A | Bolt | 8 |
| RD153-5004-0004 | Washer | 8 |
| 9022552 | Base | |
| NAS1004-8A | Bolt | 3 |
| RD153-5004-0004 | Washer | 3 |
| 9022553 | Retainer | |
| NAS1004-12A | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| NAS679C4W | Nut | 4 |
| MS15795-810 | Washer | 4 |
| 9022558 | Oxidizer check valve adapter set | |
| 9022559 | Base | |
| 9022561 | Adapter | |
| NAS1006-8A | Bolt | 2 |
| RD153-5004-0006 | Washer | 2 |

Figure 5-3. Components Adapter Set Test Kits (Sheet 4 of 10)

| Part Number | Nomenclature | Quantity (One each except as noted) |
|---|---|---|
| 9022562 | Yoke | |
| NAS1005-8A | Bolt | 2 |
| RD153-5004-0005 | Washer | 2 |
| | | |
| 9022563 | Yoke | |
| NAS1005-11A | Bolt | 2 |
| RD153-5004-0005 | Washer | 2 |
| | | |
| 9022564 | Flange | |
| NAS1004-15A | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| | | |
| 9022565 | Spacer | |
| RD262-4007-0012 | Gasket | 2 |
| | | |
| 9022566 | Flange | |
| 404673-3 | Seal | |
| NAS1004-13A | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| | | |
| 9022567 | Support | |
| NAS1005-5A | Bolt | 2 |
| RD153-5004-0005 | Washer | 2 |
| | | |
| 9022596 | Augmented spark igniter assembly adapter set | |
| 556107 | Cover | |
| 404661 | Seal | |
| RD111-1010-6410 | Bolt | 4 |
| RD153-5001-0004 | Washer | 4 |
| | | |
| 9020045-61 | Adapter | |
| 9022017 | Cap | |
| 404669 | Seal | |
| AN4-33A | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| LD153-0010-0010 | Washer | 4 |
| NAS679C4W | Nut | 4 |
| 701852 | Plug | 4 |
| 404659 | Seal | 4 |
| | | |
| 9022566 | Flange | |
| 404673-3 | Seal | |
| RD111-3003-3414 | Bolt | 4 |
| MS2002C4 | Washer | 4 |
| | | |
| 9022597 | Brace | |
| 9022598 | Plate | |
| MS28775-122 | Packing | |
| RD111-1010-6416 | Bolt | 4 |
| RD153-5001-0004 | Washer | 4 |
| | | |
| 9022690 | Helium high-pressure relief valve adapter set | |
| 9022691 | Body | |
| 9022692 | Plate | |
| MS28775-227 | Packing | |
| 404655-3 | Seal | |
| NAS1101-08-12 | Screw | 6 |
| | | |
| 9022693[a] 9022693-11[b] | Oxidizer turbo-pump adapter set | |
| 9022688-5 | Tube | 5 |
| AN807-4C | Adapter | 5 |
| AN929-4C | Cap | 5 |
| AN735-6 | Clamp | 10 |
| AN520C10R8 | Screw | 10 |
| MS15795-808 | Washer | 10 |
| NAS679C3W | Nut | 10 |
| | | |
| 9022688-9 | Tube | 2 |
| AN807-8C | Adapter | 2 |
| AN929-8C | Cap | 2 |
| AN737RM26 | Clamp | 4 |
| | | |
| 9022694 | Plate (manifold seal) | |
| MS28775-445 | Packing | |
| RD111-1009-6420 | Bolt | 30 |
| RD153-5004-0004 | Washer | 30 |
| NAS679C4W | Nut | 30 |
| | | |
| 9022695 | Plate (inlet volute turbine seal) | |
| MS28775-348 | Packing | |
| RD111-4008-6710 | Bolt | 16 |
| RD153-5002-0007 | Washer | 16 |
| | | |
| 9022696[a] 9022696-11[b] | Plate (volute seal) | |
| MS28775-451 | Packing | |
| RD111-1009-6529 | Bolt | 36 |
| RD153-5004-0005 | Washer | 36 |

(a) In components adapter set 9016796-61.
(b) In components adapter set 9016796-71.

Figure 5-3. Components Adapter Set Test Kits (Sheet 5 of 10)

| Part Number | Nomenclature | Quantity (One each except as noted) |
|---|---|---|
| 9022697 | Plate (turbine manifold seal) | |
| 5-537-1011-10 | Packing | |
| RD111-1009-6417 | Bolt | 72 |
| RD153-5004-0004 | Washer | 72 |
| NAS679C4W | Nut | 72 |
| 9022698 | Plate (volute inlet and outlet seal) | 2 |
| MS28775-140 | Packing | 2 |
| NAS679C4W | Nut | 24 |
| RD153-1002-0004 | Washer | 24 |
| 9022699 | Plate (temperature transducer mounting) | |
| MS28775-020 | Packing | |
| RD111-1009-6414 | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| AN806-C2 | Plug | 4 |
| AN814-2C | Plug | 2 |
| MS28778-2 | Packing | 2 |
| AN814-4C | Plug | 10 |
| MS28778-4 | Packing | 10 |
| 9022726 | Fuel bleed valve adapter set | |
| 9022727 | Plate (port A) | |
| RD261-3010-0012 | Seal | |
| NAS1004-9A | Bolt | 4 |
| RD153-5001-0004 | Washer | 4 |
| 9022728 | Plate (port C) | |
| RD261-3010-0033 | Seal | |
| NAS1004-9A | Bolt | 8 |
| RD153-5001-0004 | Washer | 8 |
| 9022729 | Plate (port D) | |
| RD261-3010-0018 | Seal | |
| NAS1004-18A | Bolt | 6 |
| RD153-5001-0004 | Washer | 6 |
| LD153-0011-0014 | Washer | 6 |
| NAS679C4W | Nut | 6 |

| Part Number | Nomenclature | Quantity (One each except as noted) |
|---|---|---|
| 9022730 | Plate (port E) | |
| RD261-3010-0018 | Seal | |
| NAS1004-16A | Bolt | 4 |
| RD153-5001-0004 | Washer | 4 |
| LD153-0011-0014 | Washer | 4 |
| NAS679C4W | Nut | 4 |
| 9022731 | Plate (component test) | |
| RD261-3010-0012 | Seal | |
| NAS1004-9A | Bolt | 4 |
| RD153-5001-0004 | Washer | 4 |
| RD273-1020-1002 | Plug | |
| RD261-6001-0001 | Packing | |
| 9022732 | Oxidizer bleed valve adapter set | |
| 9022725 | Plate (port H) | |
| RD261-3010-0012 | Seal | |
| NAS1004-9A | Bolt | 4 |
| RD153-5001-0004 | Washer | 4 |
| 9022731 | Plate (component test) | |
| RD261-3010-0012 | Seal | |
| NAS1004-9A | Bolt | 4 |
| RD153-5001-0004 | Washer | 4 |
| 9022733 | Plate (ports B and C) | 2 |
| RD261-3010-0016 | Seal | 2 |
| NAS1004-12A | Bolt | 6 |
| NAS1004-17A | Bolt | 6 |
| RD153-5001-0004 | Washer | 12 |
| LD153-0011-0014 | Washer | 6 |
| NAS679C4W | Nut | 6 |
| 9022734 | Plate (port D) | |
| RD261-3010-0015 | Seal | |
| NAS1004-12A | Bolt | 4 |
| RD153-5001-0004 | Washer | 4 |
| RD273-1020-1002 | Plug | |
| RD261-6001-0001 | Gasket | |
| 9022736 | Main oxidizer valve adapter set | |
| 9022731 | Plate (component test) | 2 |

Figure 5-3. Components Adapter Set Test Kits (Sheet 6 of 10)

| Part Number | Nomenclature | Quantity (One each except as noted) |
|---|---|---|
| RD261-3010-0012 | Seal | 2 |
| NAS1004-9A | Bolt | 8 |
| RD153-5004-0004 | Washer | 8 |
| 9022737 | Plate (port A) | |
| RD261-3010-0102 | Seal | |
| NAS1009-32A | Bolt | 16 |
| RD153-5004-0009 | Washer | 16 |
| 9022738 | Plate (port B) | |
| RD261-3010-0086 | Seal | |
| NAS1009-28A | Bolt | 16 |
| RD153-5004-0009 | Washer | 16 |
| 9022739 | Plate (main oxidizer valve) | 2 |
| RD262-3003-0008 | Gasket | 2 |
| NAS1004-9A | Bolt | 8 |
| RD153-5004-0004 | Washer | 4 |
| 9022739-11 | Plate (main oxidizer valve) | |
| RD261-3010-0012 | Seal | |
| NAS1004-9A | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| 9022740 | Brace (main propellant valves) | |
| NAS1004-11A | Bolt | 2 |
| RD153-5004-0004 | Washer | 2 |
| 9022741 | Leg (main propellant valves) | |
| NAS1004-16A | Bolt | 2 |
| RD153-5004-0004 | Washer | 2 |
| 9022742 | Double cap | |
| RD261-3010-0012 | Seal | |
| RD261-3010-0032 | Seal | |
| NAS1004-15A | Bolt | 8 |
| RD153-5004-0004 | Washer | 8 |
| 9022743 | Cap | |
| RD261-3010-0021 | Seal | |
| NAS1004-9A | Bolt | 6 |
| RD153-5004-0004 | Washer | 6 |
| 9022750-11 | Start tank discharge valve adapter set | |
| 9022536 | Plate (open and close ports) | |
| RD261-3010-0012 | Seal | |
| NAS1004-10A | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| 9022727 | Plate (port A) | |
| RD261-3010-0012 | Seal | |
| NAS1004-10A | Bolt | 4 |
| RD153-5001-0004 | Washer | 4 |
| 9022733 | Plate (ports B and C) | 2 |
| RD261-3010-0016 | Seal | 2 |
| NAS1004-12A | Bolt | 12 |
| RD153-5001-0004 | Washer | 12 |
| 9022746 | Plate (pneumatic port) | |
| RD261-3010-0018 | Seal | |
| NAS1004-10A | Bolt | 6 |
| RD153-5001-0004 | Washer | 6 |
| 9022752 | Plate | |
| RD261-3010-0070 | Seal | |
| NAS1006-29A | Bolt | 6 |
| RD153-5001-0006 | Washer | 6 |
| NAS1006-29A | Bolt | 8 |
| RD153-5004-0006 | Washer | 8 |
| 9022754 | Inlet plate | |
| RD261-3010-0050 | Seal | |
| NAS1006-10A | Bolt | 12 |
| RD153-5001-0006 | Washer | 12 |
| 9022751 | Four-way control valve adapter set | |
| 9022747 | Plate (inlet and vent) | |

Figure 5-3. Components Adapter Set Test Kits (Sheet 7 of 10)

| Part Number | Nomenclature | Quantity (One each except as noted) |
|---|---|---|
| 12130CR14 | K-seal | |
| 12130CR17 | K-seal | 2 |
| NAS1003-24A | Bolt | 4 |
| RD153-5004-0003 | Washer | 4 |
| MS15795-808 | Washer | 4 |
| NAS679C3W | Nut | 4 |
| | | |
| 9022748 | Cap | |
| 12130CR15 | K-seal | 2 |
| NAS1003-5A | Bolt | 4 |
| RD153-5004-0003 | Washer | 4 |
| | | |
| 9022755 | Main fuel valve adapter set | |
| 9022739-11 | Plate (main oxidizer valve) | 3 |
| RD261-3010-0012 | Seal | 3 |
| NAS1004-8A | Bolt | 12 |
| RD153-5004-0004 | Washer | 12 |
| | | |
| 9022740 | Brace (main propellant valves) | |
| NAS1004-11A | Bolt | 2 |
| RD153-5004-0004 | Washer | 2 |
| | | |
| 9022741 | Leg (main propellant valves) | |
| NAS1004-11A | Bolt | 2 |
| RD153-5004-0004 | Washer | 2 |
| | | |
| 9022774 | Plate (port A) | |
| RD261-3010-0102 | Seal | |
| NAS1009-38A | Bolt | 16 |
| RD153-5004-0009 | Washer | 16 |
| | | |
| 9022775 | Plate (port B) | |
| RD261-3010-0084 | Seal | |
| NAS1008-28A | Bolt | 16 |
| RD153-5004-0008 | Washer | 16 |
| | | |
| 9022785 | Plate | |
| RD261-3010-0020 | Seal | |
| NAS1004-8A | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |

| Part Number | Nomenclature | Quantity (One each except as noted) |
|---|---|---|
| 9022759-11 | Oxidizer turbine bypass valve adapter set | |
| 9022536 | Plate (open and close ports) | |
| RD261-3010-0012 | Seal | |
| NAS1004-10A | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| AN814-4C | Plug | |
| MS28778-4 | Packing | |
| | | |
| 9022739-11 | Plate (main oxidizer valve) | |
| RD261-3010-0012 | Seal | |
| NAS1004-11A | Bolt | 4 |
| RD153-5001-0004 | Washer | 4 |
| | | |
| 9022753 | Plate | 2 |
| RD261-3010-0086 | Seal | 2 |
| NAS1004-106A | Bolt | 14 |
| NAS1004-108A | Bolt | 2 |
| RD153-5001-0004 | Washer | 16 |
| MS15795-408 | Washer | 16 |
| NAS679C4W | Nut | 16 |
| | | |
| 9022756 | Brace | |
| NAS1003-3A | Bolt | 2 |
| RD153-5001-0003 | Washer | 2 |
| | | |
| 9022757 | Leg | |
| NAS1003-3A | Bolt | 2 |
| RD153-5001-0003 | Washer | 2 |
| | | |
| 9022773 | Gas generator control valve adapter set | |
| 9022760 | Cap (fuel inlet) | |
| RD261-3010-0022 | Seal | |
| LD153-0010-0010 | Washer | 6 |
| NAS679A4W | Nut | 6 |

Figure 5-3. Components Adapter Set Test Kits (Sheet 8 of 10)

| Part Number | Nomenclature | Quantity (One each except as noted) |
|---|---|---|
| 9022761 | Cap (actuator inlet) | |
| RD261-3010-0012 | Seal | |
| NAS1004-6A | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| 9022762 | Cap (oxidizer inlet) | |
| RD261-3010-0016 | Seal | |
| NAS1004-12A | Bolt | 6 |
| RD153-5004-0004 | Washer | 6 |
| 9022764 | Plate | |
| RD261-3010-0029 | Seal | |
| RD261-3010-0036 | Seal | |
| NAS1004-36A | Bolt | 7 |
| RD153-5004-0004 | Washer | 7 |
| LD153-0010-0010 | Washer | 7 |
| NAS679A4W | Nut | 7 |
| NAS1006-34A | Bolt | 4 |
| RD153-5004-0006 | Washer | 4 |
| LD153-0010-0014 | Washer | 4 |
| NAS879A6W | Nut | 4 |
| 9022776 | Helium regulator adapter set | |
| 9022777 | Adapter (outlet bleed) | |
| 12130CR15 | Seal | |
| NAS1101C4-22 | Screw | 2 |
| 9022778 | Plate (outlet) | 2 |
| 12130CR15 | Seal | 4 |
| NAS1101C3-16 | Screw | 8 |
| 9022779 | Plate (purge outlet) | |
| RD261-3010-0020 | Seal | |
| NAS1004-13A | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| 9022780 | Plate (inlet cover) | |
| RD261-3010-0028 | Seal | |
| NAS1004-11A | Bolt | 8 |
| RD153-5004-0004 | Washer | 8 |

| Part Number | Nomenclature | Quantity (One each except as noted) |
|---|---|---|
| 9022781 | Plate (controller cover) | |
| 2-20T | Packing | |
| NAS1101C3-10 | Screw | 6 |
| 9022791 | Plate (high-pressure relief) | |
| 2-19T | Packing | |
| NAS1101C08-14 | Screw | 6 |
| 9022792 | Plate (low-pressure relief port) | |
| 2-16T | Packing | |
| NAS1101C3-10 | Screw | 8 |
| 9022793 | Plate (four-way flange) | |
| 2-13T | Packing | 2 |
| 2-29T | Packing | 2 |
| NAS1101C3-10 | Screw | 8 |
| 9022794 | Adapter | 2 |
| 2-6T | Packing | 2 |
| 2-11T | Packing | 2 |
| NAS1004-29A | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| 9022795 | Plate (regulator bleed cover) | |
| 2-19T | Packing | |
| NAS1101C3-10 | Screw | 8 |
| 9022796 | Tube | |
| 550931 | Union | 2 |
| 2-12T | Packing | 2 |
| 701853 | Plug | 2 |
| 2-12T | Packing | 2 |
| 9022782 | Augmented spark igniter valve adapter set | |
| 9022731 | Plate (component test | |

Figure 5-3. Components Adapter Set Test Kits (Sheet 9 of 10)

| Part Number | Nomenclature | Quantity (One each except as noted) |
|---|---|---|
| RD261-3010-0012 | Seal | |
| NAS1004-9A | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| 9022739-11 | Plate (main oxidizer valve) | |
| RD261-3010-0012 | Seal | |
| NAS1004-9A | Bolt | 4 |
| RD153-5004-0004 | Washer | 4 |
| 9022797 | Cap | |
| RD261-3010-0009 | Seal | |
| RD261-3010-0032 | Seal | |
| NAS1004-24A | Bolt | 8 |
| RD153-5004-0004 | Washer | 8 |
| MS15795-810 | Washer | 8 |
| NAS679C4W | Nut | 8 |
| 9022798 | Plate (port D) | |
| RD261-3010-0012 | Seal | |
| NAS1101C4-18 | Screw | 4 |
| 9022783 | Propellant utilization valve adapter set | |
| 9022745 | Plate | 2 |
| RD261-3010-0036 | Seal | 2 |
| NAS1004-26A | Bolt | 12 |
| NAS1004-31A | Bolt | 12 |
| RD153-5004-0004 | Washer | 24 |
| MS15795-810 | Washer | 24 |
| NAS679C4W | Nut | 24 |
| 9022784 | Vent-and-relief valve adapter set | |
| 9020045-51 | Adapter | |
| 9020045-61 | Adapter | |
| 9022768 | Retainer | |
| 9022769 | Plate | |
| 9022770 | Plate | 2 |
| NAS1004-48A | Bolt | 2 |
| RD153-5004-0004 | Washer | 2 |
| MS15795-810 | Washer | 2 |
| NAS679C4W | Nut | 2 |
| 9022771 | Bar | 2 |
| NAS1006-3A | Bolt | 2 |
| RD153-5004-0006 | Washer | 2 |
| 9022772 | Inlet plate | |
| MS28775-228 | Packing | |
| NAS1006-38A | Bolt | 6 |
| NAS1006-40A | Bolt | 2 |
| RD153-5004-0006 | Washer | 8 |
| MS15795-814 | Washer | 6 |
| NAS679C6W | Nut | 6 |
| 9022786 | Spark igniter adapter set | |
| 9022787 | Plate | |
| RD262-4006-0134 | Packing | |
| NAS1003-10A | Bolt | 8 |
| RD153-5004-0003 | Washer | 8 |
| MS15795-808 | Washer | 8 |
| NAS679C3W | Nut | 8 |
| PG2-125-A-N | Packing | |
| 9022800 | Sequence control valve adapter set | |
| 9020045-61 | Adapter | |
| 9022733 | Plate (ports B and C) | |
| RD261-3010-0016 | Seal | |
| NAS1004-16A | Bolt | 6 |
| RD153-5004-0004 | Washer | 6 |
| RD114-8003-0004 | Nut | 6 |
| 9022739-11 | Plate (main oxidizer valve) | 2 |
| 9022799 | Plate (retainer) | |
| RD261-3010-0012 | Seal | 2 |
| NAS1004-12A | Bolt | 8 |
| RD153-5004-0004 | Washer | 16 |

Figure 5-3. Components Adapter Set Test Kits (Sheet 10 of 10)

5-8. COMPONENTS ADAPTER SET ACCESSORIES. The accessories consist of fittings, valves, hose assemblies, filters, tube assemblies, and electrical cables used to support test equipment, test kits, and Components Test Console G3107. Figure 5-4 lists accessories included in the components adapter set.

5-9. STORAGE CABINET. Components adapter set storage cabinet 19-9018996-1 is provided for storing items of the components adapter set except the leak detector unit. The cabinet is 48.5 inches wide, 72 inches high, and 25 inches deep and has two flush-mounted doors. The cabinet contains one fixed and four adjustable shelves, and 24 drawers supplied with 72 drawer dividers.

| Part Number | Nomenclature | Quantity (One each except as noted) |
|---|---|---|
| F-5398 | Filter | 2 |
| 19-9021905-1 (b) | | |
| 8114 | Packing (housing backup) | |
| 4114-20 | Packing (housing) | |
| 4011-20 | Packing (element) | |
| 411G-5DM | Element | |
| 41567-1 | Plug | |
| 41566-1 | Case | |
| F-5399 | Filter | 2 |
| 19-9021905-2 (b) | | |
| 8118 | Packing (housing backup) | |
| 4118-20 | Packing (housing) | |
| 4111-20 | Packing (element) | |
| 412G-5DM | Element | |
| 41478-1 | Plug | |
| 41477-1 | Case | |
| FL2436004 | Bag | 6 |
| GA7016-4-0140 | Orifice | |
| NA5-28026T14S | Hand valve | 2 |
| NA5-28026T16S | Hand valve | |
| 699 | Universal test lead | |
| 2680-LOX | Temperature transducer | |
| 3088-7 | Patch-cord | |
| 3088-8 | Patch-cord | |
| 3088-9 | Patch-cord | 3 |
| 3088-10 | Patch-cord | |
| 3088-11 | Patch-cord | |

| Part Number | Nomenclature | Quantity (One each except as noted) |
|---|---|---|
| 404659 | Seal | 8 |
| 701852 | Plug | 8 |
| 9012997-5 | Vise | |
| 9021826 | Tube | |
| 9021827 | Tube | |
| 9021828 | Tube | |
| 9021829 | Tube | |
| 9021830 | Tube | |
| 9021831 | Tube | |
| 9021832 | Tube | |
| 9021833 | Tube | |
| 9021834 | Tube | |
| 9021835 | Tube | |
| 9021836 | Tube | |
| 9021837 | Tube | |
| 9021838 | Tube | |
| 9021839 | Tube | |
| 9021840 | Tube | |
| 9021841 | Tube | |
| 9021842 | Tube | |
| 9021843 | Tube | 14 |
| 9021850 | Tube | |
| 9021851 | Tube | |
| 9021852 | Tube | |
| 9021853 | Tube | |
| 9021881 | Tube | |
| 9022409 | Tube | 2 |
| 9026538 | Cable | |
| 103317 (b) | | |
| 9026539 | Cable | |
| 103423 (b) | | |
| 9026540 | Cable | |
| 103190 (b) | | |
| 9026541 | Cable | |
| 103191 (b) | | |
| 9026542 | Cable | |
| 103192 (b) | | |
| 9026543 | Cable | |
| 103193 (b) | | |

(b) Allowable alternate

Figure 5-4. Components Adapter Set Accessories (Sheet 1 of 3)

| Part Number | Nomenclature | Quantity (One each except as noted) |
|---|---|---|
| 9026544<br>103194(b) | Cable | |
| 9026545<br>103195(b) | Cable | |
| 9026546<br>103196(b) | Cable | |
| 9026547<br>103197(b) | Cable | |
| 9026548<br>103198(b) | Cable | |
| 9026549<br>103310(b) | Cable | |
| 19-9013924 | Valve connection | |
| 19-9014938-32<br>(R24525-4-0480)(c) | Hose (5,000 psig) | 14 |
| 19-9014938-33<br>(R23429A-6-0360)(c) | Hose (3,000 psig) | 4 |
| 19-9014938-34<br>(R24529A-6-0480)(c) | Hose (3,000 psig) | 4 |
| 19-9014938-35<br>(R24529A-8-0480)(c) | Hose (3,000 psig) | 3 |
| 19-9017276-1 | Burst diaphragm (40 psig) | 9 |
| 19-9017276-6 | Burst diaphragm (90 psig) | |
| 19-9017276-8 | Burst diaphragm (120 psig) | |
| 19-9017276-9 | Burst diaphragm (140 psig) | |
| 19-9017276-20 | Burst diaphragm (450 psig) | 3 |
| 19-9017276-21 | Burst diaphragm (500 psig) | |
| 19-9017276-24 | Burst diaphragm (650 psig) | 2 |
| 19-9017276-27 | Burst diaphragm (800 psig) | 3 |

| Part Number | Nomenclature | Quantity (One each except as noted) |
|---|---|---|
| 19-9017276-29 | Burst diaphragm (900 psig) | 3 |
| 19-9017276-32 | Burst diaphragm (1,100 psig) | 4 |
| 19-9017276-36 | Burst diaphragm (1,500 psig) | 3 |
| 19-9017276-37 | Burst diaphragm (1,600 psig) | 2 |
| 19-9017276-38 | Burst diaphragm (1,700 psig) | 4 |
| 19-9017276-39 | Burts diaphragm (1,800 psig) | 3 |
| 19-9017276-40 | Burst diaphragm (1,900 psig) | 2 |
| 19-9017276-42 | Burst diaphragm (2,100 psig) | 3 |
| 19-9017276-43 | Burst dia- (2,200 psig) | |
| 19-9017276-48 | Burst dia- (2,700 psig) | |
| 19-9017276-51 | Burst diaphragm (3,000 psig) | |
| 19-9021927-3<br>(105047-3600)(c) | Hose (1,500 psig) | 3 |
| 19-9021927-4<br>(105047-4800)(c) | Hose (1,500 psig) | 4 |
| 19-9021927-5<br>(105248)(c) | Hose (1,500 psig) | 8 |
| 19-9021931-1<br>(23711598)(c) | Accumulator | 3 |
| 19-9021931-2<br>(23711599)(c) | Accumulator | |
| 19-9021933<br>(204A019-1)(c) | Manifold | |

(b) Allowable alternate
(c) Part may be identified with only the number in parentheses, with the 19- number and the number in parentheses, or with the 19- number and another number not listed in this figure.

Figure 5-4. Components Adapter Set Accessories (Sheet 2 of 3)

| Part Number[a] | Nomenclature | Quantity (One each except as noted) | Part Number[a] | Nomenclature | Quantity (One each except as noted) |
|---|---|---|---|---|---|
| 19-9021936 (5551GX12TPT-4)[c] | Cryogenic hand valve | 2 | AN919-21C | Reducer | 2 |
| | | | AN919-23C | Reducer | 2 |
| 19-9023474-54 (77-NAA-093-54)[c] | Burst diaphragm (3,750 psig) | 2 | AN929-2C | Cap | 4 |
| | | | AN929-4C | Cap | 40 |
| | | | AN929-6C | Cap | 24 |
| AN737TW30 | Clamp | 2 | AN929-8C | Cap | 20 |
| AN784C4 | Tee | | AN929-12C | Cap | 16 |
| AN804C4 | Tee | | AN937C4 | Cross | 3 |
| AN804C8 | Tee | | AN937C6 | Cross | 12 |
| AN814-2C | Plug | 4 | AN937C8 | Cross | 12 |
| AN814-3C | Plug | 4 | AN938C4 | Tee | 4 |
| AN814-4C | Plug | 10 | AN938C6 | Tee | 3 |
| AN814-6C | Plug | 3 | AN938C8 | Tee | 6 |
| AN814-8C | Plug | 36 | AN938C12 | Tee | 4 |
| AN814-16C | Plug | 3 | AN6289C4 | Nut | 6 |
| AN815-4C | Union | 40 | AN6289C6 | Nut | 6 |
| AN815-6C | Union | 18 | AN6289C8 | Nut | 4 |
| AN815-8C | Union | 4 | AN6289C12 | Nut | 6 |
| AN815-12C | Union | 8 | MS20913-2CR | Plug | 2 |
| AN824-4C | Tee | 2 | MS21900C4 | Adapter | 6 |
| AN832-4C | Union | 5 | MS28777-4 | Ring | 24 |
| AN832-6C | Union | 4 | MS28777-6 | Ring | 24 |
| AN832-8C | Union | 4 | MS28777-8 | Ring | 24 |
| AN832-12C | Union | 6 | MS28777-12 | Ring | 24 |
| AN893-2C | Bushing | 2 | MS28778-4 | Packing | 144 |
| AN893-4C | Bushing | 2 | MS28778-5 | Packing | 12 |
| AN893-12C | Bushing | 12 | MS28778-6 | Packing | 144 |
| AN893-22C | Bushing | 3 | MS28778-8 | Packing | 36 |
| AN894C12-8 | Bushing | 2 | MS28778-12 | Packing | 36 |
| AN910-2C | Coupling | 2 | RD273-1009-0020 | Restrictor | 2 |
| AN919-1C | Reducer | 3 | RD273-1009-0080 | Restrictor | |
| AN919-6C | Reducer | 18 | RD273-1009-0140 | Restrictor | |
| AN919-10C | Reducer | 8 | RD273-3004-0001 | Reducer | 2 |
| AN919-12C | Reducer | 3 | RD273-3004-0002 | Reducer | 2 |
| AN919-16C | Reducer | 10 | 4C6X-SS | Elbow | 12 |
| AN919-18C | Reducer | 6 | 4R6X-SS | Tee | 6 |
| AN919-19C | Reducer | 2 | 12C6X-SS | Elbow | 12 |

(a) When replacing AN or MS fittings, replace type C with type J.
(c) Part may be identified with only the number in parentheses, with the 19- number and the number in parentheses, or with the 19- number and another number not listed in this figure.

Figure 5-4. Components Adapter Set Accessories (Sheet 3 of 3)

5-10. CONFIGURATION CHANGES--MANUAL EFFECTIVITY.

5-11. Incorporated modifications that changed the configuration of the components adapter set are listed in figure 5-5. Specifically, the modifications are as follows:

a. Components adapter set 9016796-11 provides the capability of testing oxidizer turbine bypass valve 408020. The addition of plate 9022536 changes the oxidizer turbine bypass valve adapter set from 9022759 to 9022759-11.

| Approved ECP No. | Dash No. | Incorporated In Manual Dated |
|---|---|---|
| J2-156 | -11 | 29 March 1965 |
| J2-162 | -21 | 29 March 1965 |
| J2-242 | -51 | 29 March 1965 |
| J2-262 | -31 | 29 March 1965 |
| J2-269 | -41 | 29 March 1965 |
| J2-339 | -61 | 19 October 1965 |
| J2-703 | -71 | 25 June 1971 |

Figure 5-5. Configuration Changes--Manual Effectivity

b. Components adapter set 9016796-21 provides the capability of testing the propellant bleed valves by the addition of bleed valve adapter set 9022447-11 and burst diaphragms 19-9017276-9 and 19-9017276-21.

c. Components adapter set 9016796-31 facilitates leak checking of the oxidizer turbine heat exchanger coil by the addition of heat exchanger adapter set 9021876, tube assembly 9021881, and burst diaphragms 19-9017276-8 and 19-9017276-48.

d. Components adapter set 9016796-41 provides the capability of performing a functional check of the fuel jacket fuel purge check valve by the addition of fuel jacket purge check valve adapter set 9021887.

e. Components adapter set 9016796-51 provides the capability of performing a dc dielectric strength test of the spark igniters by the addition of spark igniter dielectric test adapter set 9021901 and burst diaphragm 19-9017276-51.

f. Components adapter set 9016796-61 provides additional capability to perform component leakage tests by the addition of the following parts:

(1) Inlet volute plate 9021956 and bolts RD111-1009-6642 are added to the turbopump adapter set 9021780 to create set 9021780-11.

(2) Outlet and dual temperature probe ports adapter assembly 9021957, seal RD261-3010-0012, bolts NAS1004-16A, washers RD153-5004-0004, plug AN814-4C, and packing MS28778-4 are added to bleed valve adapter set 9022447 to create 9022447-11.

(3) Open and close ports plate 9022536, seal RD261-3010-0012, bolts NAS1004-10A and NAS1006-29A, and washers RD153-5004-0004 and RD153-5004-0006 are added to start tank discharge valve adapter set 9022750 to create 9022750-11.

(4) Plugs 701852 and seals 404659.

g. Components adapter set 9016796-71 provides the capability of using a test plate as a protective cover for removal and installation procedures. Test plate (volute seal) 9022696 was reworked to flush 4 attach bolts and provide 4 tethered bolts and a tethered streamer. The oxidizer turbopump adapter set 9022693 and the plate (volute seal) 9022696 were reidentified as -11.

5-12. <u>MAINTENANCE AND REPAIR OF COMPONENTS ADAPTER SET.</u>

5-13. Maintenance required to ensure operation of the components adapter set is listed in figure 5-6. Information presented outlines the tasks to be performed, when the tasks shall be performed, and where the data support for these tasks will be found. When replacing parts, see figures 5-1 through 5-4 for part identification. The components adapter set must be kept in an environmentally controlled cleanroom.

5-14. MAINTENANCE AND REPAIR OF LEAK DETECTOR SET.

5-15. Maintenance and repair procedures for leak detector set (figure 5-7) consists of assembly, startup, Diatron adjustment, calibration, operation, securing, and shutdown. Additional maintenance, operating, testing, and repairing instructions are contained in the Operation and Maintenance Manuals provided with the units. (See figure 5-1 for applicable manual.) See figure 5-8 for test equipment required. Perform applicable operating procedures presented in figure 5-9 and supported by figures 5-10 through 5-12. The functional test requirement for the set is satisfied by demonstrating that the helium OUTPUT meter reading is not increased when all system joints are sprayed with helium gas (test port plugged and test valve open). Calibration requirements are satisfied by accomplishing applicable procedures in figure 5-9. The OUTPUT, multipurpose, and TEST PORT PRESSURE meters do not require calibration. Internal adjustments R-112 (PROTECTION SENSITIVITY) and R-113 (GAUGE CALIBRATE) are factory-set adjustments that must not be changed.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect components adapter set for completeness. | X | | X | | Refer to paragraph 5-1. |
| Inspect storage cabinet for: | | | | | |
| Cleanness | X | | X | X | Every 6 months. Refer to R-3825-5, Volume I. |
| Scratches | X | | | | Paint exposed and scratched surface with grey semigloss enamel (Federal Specification TT-E-529), color 26251 (Federal Standard 595). |
| Inspect test equipment for | | | | | |
| Cleanness | X | X | | X | After function testing. |
| Scratches | X | | | | Repair according to type of surface. Refer to R-3825-5, Volume I. |
| Broken glass | X | X | | | Replace glass as necessary. |
| Inspect leak detector set for: | | | | | |
| Interior cleanness | | | | X | Prior to function testing. |
| Damaged standard leak | X | X | | | Replace standard leak. |
| Inspect flowrate tester for damaged precision tube. | X | X | | | Replace flowrate tester. |
| Inspect test kit components for: | | | | | |
| Cleanness | | X | | | Refer to R-3825-5, Volume I. |
| Scratched or nicked sealing surfaces | X | X | | | Replace component. |
| Damaged packing or seals | | X | | | Replace packing or seal. |
| Galling or thread wear | | X | | | Replace threaded component. |
| Damaged tube assembly (galled B-nut or scratched flare) | | X | | | Replace tube assembly. |
| Inspect accessory components for: | | | | | |
| Cleanness | | X | | | Refer to R-3825-5, Volume I. |
| Scratched or nicked sealing surfaces | X | X | | | Replace component. |
| Damaged packings | | X | | | Replace packing. |
| Galling or thread wear | | X | | | Replace threaded component. |
| Damaged tube assembly (galled B-nut or scratched flare) | | X | | | Replace tube assembly. |
| Inspect hand valves for ease of operation | | X | | | Replace valve. |
| Calibrate leak detector set. | | X | | X | Twice daily when in use. Refer to paragraph 5-14. |
| Function-test leak detector set. | | | | X | Every 6 months and whenever a malfunction is suspected. Refer to paragraph 5-14. |

Figure 5-6. Maintenance Requirements--Components Adapter Set (Sheet 1 of 3)

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks. |
|---|---|---|---|---|---|
| Verify actual leak rate of standard leak. | | | | X | Every 6 months. Establish actual leak rate emitted from leak port of standard leak, using equipment having an accuracy of ±10%. |
| Function-test flowrate tester and stopwatch. | | | | X | Every 6 months and whenever a malfunction is suspected. Refer to paragraph 5-21. |
| Check accuracy of stopwatch. | | | | X | Every 6 months. Refer to paragraph 5-22. |
| Function-test high-voltage leakage tester. | | | | X | Every 6 months and whenever a malfunction is suspected. Refer to paragraph 5-27. |
| Calibrate high-voltage tester. | | | | X | Every 6 months. Refer to paragraph 5-28. |
| Function-test dc Hypot. | X | | | X | Every 6 months and whenever a malfunction is suspected. Refer to paragraph 5-33. |
| Check accuracy of dc Hypot. | | | | X | Every 6 months. Refer to paragraph 5-34. |
| Test temperature transducer. | X | | | X | Every 6 months and whenever a malfunction is suspected. Refer to paragraph 5-43. |
| Test continuity of electrical cables. | | | | X | Every 6 months and whenever a malfunction is suspected. Refer to paragraph 5-45. |
| Test patch cords | | | | X | Every 6 months and whenever a malfunction is suspected. Refer to paragraph 5-47. |
| Test hand valves. | | | | X | Every 6 months and whenever leakage is suspected. Refer to paragraph 5-41. |
| Test connection valve. | | | | X | Every 6 months and whenever leakage is suspected. Refer to paragraph 5-42. |
| Test manifold. | X | | | X | Every 6 months and whenever leakage is suspected. Refer to paragraph 5-44. |
| Proof pressure-test hoses. | | | | X | Every 6 months. Refer to paragraph 5-46. |
| Install mercury seal in flowrate tester | | | | X | Prior to initial use. Refer to paragraph 5-19. |
| Remove mercury seal from flowrate tester. | | | | X | Prior to long-term storage or shipment. Refer to paragraph 5-20. |
| Lubricate protection throttle valve of leak detector unit | | | | X | Every 6 months with chlorotrifluoroethylene grease, Type I RB0140-011 (Rocketdyne). Refer to maintenance manual supplied with leak detector for valve disassembly and assembly. |

Figure 5-6. Maintenance Requirements--Components Adapter Set (Sheet 2 of 3)

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Clean portable environmental test chamber. | | X | | | Refer to paragraph 5-24. |
| Clean test kit components. | | X | | | Refer to R-3825-5, Volume I. |
| Clean accessory components. | | X | | | Refer to R-3825-5, Volume I. |

Figure 5-6. Maintenance Requirements--Components Adapter Set (Sheet 3 of 3)

5-16. ASSEMBLING LEAK DETECTOR SET. The leak detector set is shipped with some components packaged separately. To install these components, refer to applicable Operation and Maintenance Manual. (See figure 5-1.) Assemble leak detector set as follows:

a. Place leak detector unit and test port station on movable work stands and orient them to the cutouts provided.

b. Secure auxiliary vacuum pump on lower shelf of workstand that supports test port station.

c. Install 2-inch-diameter flexible hose 133688 between auxiliary vacuum pump and test port station. Cut hose as necessary to obtain a minimum length without binding of pump mounts.

d. Position test port station and leak detector unit flanges for alinement by adjusting workstand heights as necessary.

e. Place a flat rubber gasket between flanges, and install flange bolts. Cross-torque flange bolts to 35-45 in-lb.

f. Disable automatic protection feature of protection throttle valve as follows:

(1) On detector units equipped with an AUTOMATIC PROTECTION switch or VALVE OVERRIDE switch (located on left side of tilt-out chassis), move switch to OFF.

(2) On detector not equipped with switch listed in substep 1, disconnect electrical connector J-112 from solenoid valve L-102 (located at bottom of detector tilt-out chassis) and connect electrical cable 133472 between solenoid valve L-102 connector and receptacle J-207 (located in test port station).

g. Remove vent exhaust section from auxiliary pump, and install pump adapter 133739. Make sure that valve on pump adapter valve is closed.

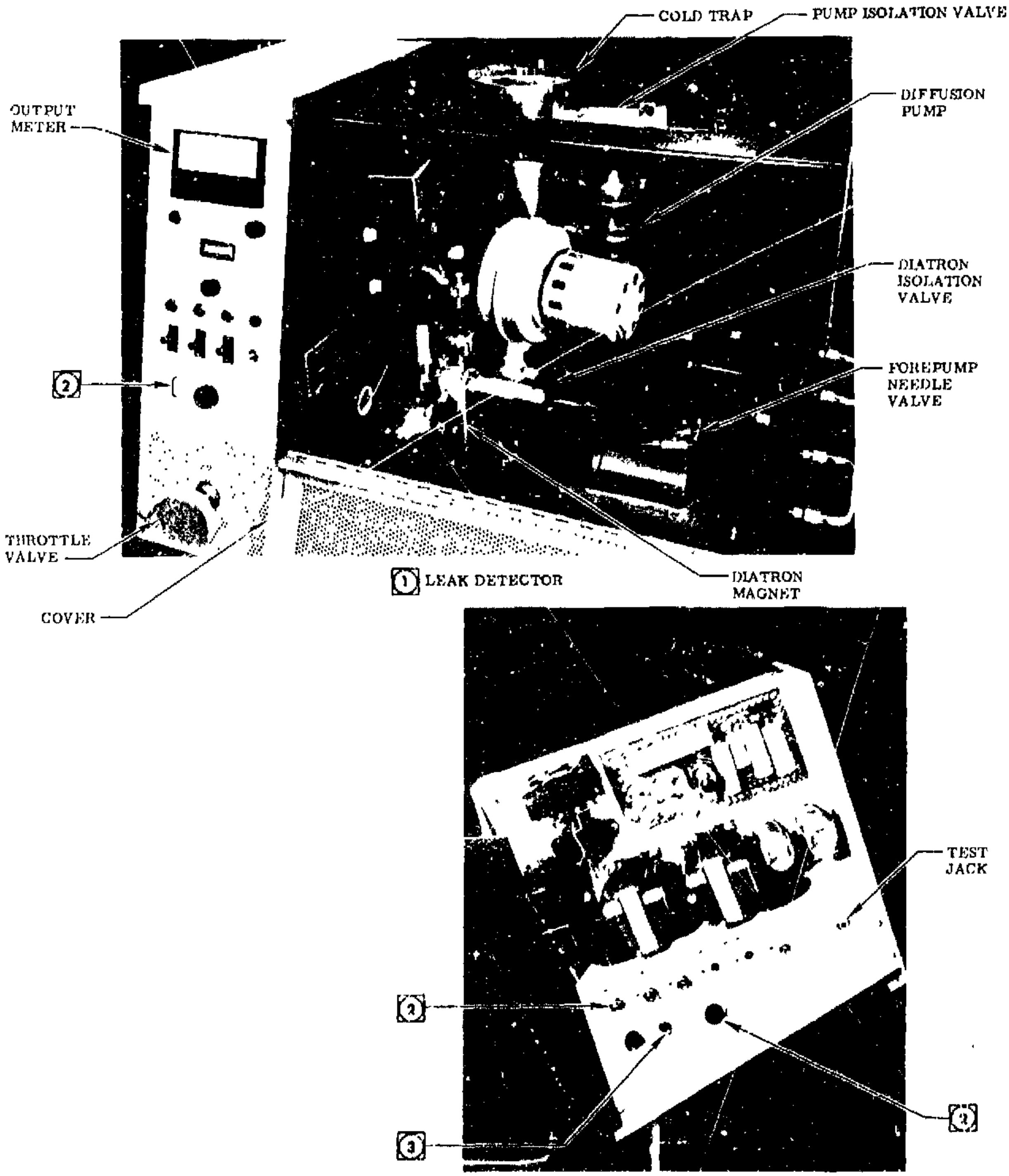
h. Attach vinyl tubing (or rubber vacuum tubing) between pump adapter 133739 and test port station ballast tank check valve.

i. Connect electrical cables between connector J-110 on leak detector unit and plug P-207 in test port station.

j. Function-test leak detector set. (Refer to paragraph 5-14.)

5-17. MAINTENANCE OF FLOWRATE TESTER AND STOPWATCH.

5-18. Maintenance consists of testing and calibrating the tester and stopwatch, and installing and removing a mercury seal in the flowrate tester. The seal is installed by adding mercury to the tester piston and adjusting the piston screw until the seal is formed in the piston groove. The seal is removed by removing mercury from the piston.




1 MODEL 24-120B ILLUSTRATED

2 NOT INCORPORATED ON MODEL 24-120A

3 REPOSITIONED AND PLACARDED AUTOMATIC PROTECTION OR VALVE OVERRIDE ON MODEL 24-120A

J2-5-2-33

Figure 5-7. Leak Detector Set

| Equipment Required | Use |
|---|---|
| 0-500 microampere meter | Adjusting Diatron |
| 3-circuit phone plug, Type 267 (Switch-craft), or equivalent | To connect 0-500 microampere meter into leak detector test jack |
| Helium spray device consisting of the following: | Function testing (Refer to paragraph 5-14.) |
| Helium source (Refer to R-3825-5, Volume I.) Regulator spray nozzle hose | |

Figure 5-8. Test Equipment--Leak Detector Set

## 5-19. INSTALLING MERCURY SEAL.

a. Remove screws that secure front and rear panels. Remove panels.

CAUTION

The precision tube is released when the stem nut is loosened. Damage to the tube can result if the tube is allowed to fall.

b. Loosen stem nut and attached seal plug on top of flowrate tester.

c. Lift out precision tube and remove piston from tube.

d. Clean precision tube. (Refer to R-3825-5, Volume I.)

e. Wet precision tube inside and outside with antistatic solution supplied with flowrate tester.

f. Wipe precision tube dry with a clean, lint-free cloth.

g. Clean piston. (Refer to R-3825-5, Volume I.)

h. Remove screw from piston.

i. Hold precision tube in a vertical position and insert piston in precision tube until piston groove is within bore of precision tube; hold piston in this position.

j. Pour several drops of mercury into screw hole in piston.

k. Insert screw into piston and tighten screw until piston groove fills with a continuous ring of mercury.

l. Place hand on bottom of tube and release piston.

m. Invert tube several times. Mercury will overflow if the piston groove is overfilled.

n. Adjust screw on piston until a continuous ring of mercury is obtained in piston groove. Air bubbles must not be present in mercury.

o. Insert tube in flowrate tester frame, placing end of tube on bottom rubber seat first.

p. Slowly tighten stem nut and attach seal plug until contact is made with top of precision tube.

q. Make sure precision tube is centered on rubber seats.

r. Tighten stem nut and attached seal plug until a compression seal is obtained.

s. Install front and rear panels with 4 screws in each.

t. Test flowtester. (Refer to paragraph 5-21.)

## 5-20. REMOVING MERCURY SEAL.

a. Remove screws that secure front and rear panels. Remove panels.

CAUTION

The precision tube is released when the stem nut is loosened. Damage to the tube can result if the tube is allowed to fall.

b. Loosen stem nut and attached seal plug on top of flowrate tester.

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|

NOTE: The following abbreviations are used in this figure:

| | |
|---|---|
| Loc | Location |
| LD | Leak detector |
| TPS | Test port station |
| AP | Auxiliary pump |
| CP | Leak detector control panel |
| EP | Electronics panel |

LEAK DETECTOR STARTUP

NOTE: Leak detector startup is completed by performing steps 1 through 24.

- Disregard TPS requirements when test port station is not connected.
- Delete steps preceded by an asterisk if equipment was not completely shutdown.

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 1 | CP<br>TPS<br>AP | *Make sure all power switches are in off position; that POWER, DIFFUSION pump, and GAGE circuit breakers are released (press release lever located below each circuit breaker); and that FILAMENT switch is off. | LD<br>TPS<br>AP | All lights are off and pumps are not operating. |
| 2 | AP | *Check auxiliary pump (roughing pump) oil level and, if necessary, fill with Duo Seal pump oil 60786-43 (Bell & Howell Co). | AP | |
| 3 | AP | *Remove belt guard, and manually rotate pump one revolution to make sure pump moves freely. Replace belt guard. | AP | |
| 4 | LD | *Open front cover of leak detector unit, check oil level of forepump and, if necessary, fill using Duo Seal pump oil 60786-43 (Bell & Howell Co). | LD | |
| 5 | LD | *Manually rotate forepump one revolution to make sure pump moves freely. | LD | |
| 6 | LD | Make sure pump isolation valve (at top of cold trap) and Diatron valve (at bottom of cold trap) are open. | LD | Vacuum system is ready f~ operation. |

Figure 5-9. Operating Procedures for Leak Detector Set (Sheet 1 of 12)

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 7 | LD | Make sure there is a minimum of one foot of clearance at rear of leak detector unit. | LD | Adequate clearance for air circulation to cool diffusion pump. |
| 8 | LD | *Connect power cords of leak detector, test port station, and auxiliary pump to facility 115(±10%) vac, 60-cycle supply. | | |
| 9 | LD | Make sure throttle valve handwheel is turned fully clockwise. (Do not overtighten valve.) | LD | Throttle valve is closed (isolates leak detector from test port station or test setup). |
| 10 | | Install standard leak 141430-8 or 25643-1 (Bell & Howell Co) as follows: | | |
| | TPS | a. If test port station is connected, install standard leak in quick-disconnect fixture on test port station. | | |
| | LD | b. If test por station is not connected, install s andard leak, adapter, and a fast-response inlet manifold (Bell & Howell Co) at leak detector inlet. | | |
| 11 | TPS | Make sure that red indicator on TEST PORT PRESSURE meter is set at 30 microns (maximum). | TPS | Setting selects actuation pressure for TEST valve. |
| 12 | AP | *Turn on auxiliary pump (roughing pump) power switch. | AP | Auxiliary pump operates. |
| 13 | TPS | Make sure VENT TEST switch is at TEST. | | |

CAUTION: In the following procedure, the AUTOMATIC PROTECTION switch on the leak detector unit must remain at ON if test port station is not connected. Moving the switch to OFF opens the automatic portion of the automatic protection and throttle valve exposing the Diatron filament to any damaging pressure surges that may occur.

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 14 | EP | If test port station is connected, tilt leak detector control panel forward and move AUTOMATIC PROTECTION switch to OFF. (If AUTOMATIC PROTECTION switch is not provided, disconnect connector P112 from L102 solenoid and install special cable 136472 (Bell & Howell Co) between L102 solenoid and J207 | TPS | TEST valve provides pressure burst protection. |

Figure 5-9. Operating Procedures for Leak Detector Set (Sheet 2 of 12)

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 14 (cont) | | on test port station.) Replace control panel. If test port station is not connected, make sure that AUTOMATIC PROTECTION switch is at ON. | | |
| 15 | TPS | Move test port station POWER switch to POWER. | TPS | POWER light comes on. NO TEST light comes on. Roughing valve opens. |
| 16 | CP | Press leak detector unit POWER circuit breaker. | LD | POWER light comes on. Forepump operates. Diffusion pump blower operates. AUTOMATIC PROTECTION OFF light comes on (if installed and if test port station is connected). |
| 17 | LD | Wait until forepump operates quietly (approximately 1-3 minutes), and then press DIFFUSION pump circuit breaker. | LD | DIFFUSION PUMP light comes on. (Diffusion pump operates.) |
| 18 | LD | Allow 15 minutes (or more) for diffusion pump oil to warm up. | LD | Pump oil reaches operating temperature. |

WARNING: In the following step, eye protection and protective clothing must be worn by personnel handling liquid nitrogen containers to prevent the liquid from contacting any part of the body. Human tissue will freeze upon contact causing serious injury.

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 19 | LD | Fill cold trap with liquid nitrogen (MIL-P-27401) to a level no higher than 2 inches from top of cold trap bucket. | | |
| 20 | CP | Obtain pressure indication as follows: | | |
| | | a. Move multipurpose switch to PRESSURE. | | |
| | | b. Press GAUGE circuit breaker. (Pressure indication may go off scale temporarily.) | LD | GAUGE light comes on. |
| | | c. Observe meter for result; then proceed to step 21. If result is not obtained, proceed immediately to substep d. | LD | Pressure indication is 0.2 microns or less. |
| | | d. Release GAUGE circuit breaker, and repeat substeps b and c at approximately one-minute intervals until result of substep c is obtained. Make sure throttle handwheel is turned fully clockwise. If result is not obtained within 45 | LD | GAUGE light goes off and comes on as operated. |

Figure 5-9. Operating Procedures for Leak Detector Set (Sheet 3 of 12)

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 20 (cont) | | minutes of start of diffuser pump operation (step 17), terminate operation by performing procedural steps for securing leak detector for more than 24 hours and complete shutdown of leak detector. Refer to applicable Operation and Maintenance Manual (Bell & Howell Co). | | |
| 21 | CP | Move FILAMENT switch to ON. If 1st result does not occur, move FILAMENT switch to RESET momentarily, then to ON. Check that multipurpose meter indicates 0.2 microns or less. If pressure is greater, return to step 20. If pressure is 0.2 microns or less and FILAMENT light is not on, terminate test and refer to applicable Operation and Maintenance Manual (Bell & Howell Co). If 2nd result does not occur, check TEST PORT PRESSURE meter. If black indicator has not contacted red indicator, check vacuum system for apparent leakage. If indicators appear to have contacted, refer to applicable Operation and Maintenance Manual (Bell & Howell Co). | CP<br>TPS | (1) FILAMENT light comes on.<br>(2) NO TEST light goes off, and TEST light comes on. |
| 22 | TPS | Evacuate interconnect between test port station and leak detector unit as follows:<br>a. If test port station is equipped with a TEST VALVE OVERRIDE switch, actuate switch and hold for approximately 7-10 seconds, then release.<br>b. If test port station is not equipped with TEST VALVE OVERRIDE switch, very cautiously open THROTTLE valve on leak detector until a reaction is noted on multipurpose meter. Do not permit indication to go off scale. Close THROTTLE valve when pressure stabilizes at or below 0.2 microns. | | |

Figure 5-9. Operating Procedures for Leak Detector Set (Sheet 4 of 12)

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 23 | LD | If standard leak is installed on fast-response inlet manifold (substep b of step 10), open valve leading to standard leak and close other valve(s) on inlet manifold. | | |
| 24 | CP | Move FILAMENT switch to OFF. | CP | (1) FILAMENT light goes off. |
| | | | TPS | (2) TEST light goes off, and NO TEST light comes on. |

CALIBRATION

NOTE: If Diatron filament element has been replaced, leak detector must be adjusted for optimum setting (steps 73 through 88) prior to calibration.

- Leak detector startup procedure must be accomplished prior to step 25.
- Calibration procedure is completed by performing steps 25 through 40.
- Disregard TPS requirements if test port station is not connected.

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 25 | TPS | Make sure VENT TEST switch is at VENT. | TPS | Vent valve is open, and test valve is closed. |
| 26 | LD | Make sure throttle valve handwheel is turned fully clockwise. (Do not overtighten valve.) | LD | Throttle valve closed. |
| 27 | | If not already installed, install standard leak 141430-8 or 25643-1 (Bell & Howell Co) as follows: | | |
| | TPS | a. If test port station is connected, install standard leak in quick-disconnect fixture of test port station. | | |
| | LD | b. If test port station is not connected, install standard leak in adapter on fast-response inlet manifold (step 10, substep b). Open valve leading to standard leak, and close other valve(s) on inlet manifold. | | |
| 28 | | Record values as follows: | | |
| | | a. Record ambient temperature in vicinity of standard leak as value $A_1$. | | |

Figure 5-9. Operating Procedures for Leak Detector Set (Sheet 5 of 12)

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 28 (cont) | | b. Record calibration temperature, marked on standard leak as value $A_2$.<br><br>c. Record calibration value (leak rate), marked on standard leak, as value B. | | |
| 29 | CP | Move MULTIPLIER selector switch to X1 and turn ZERO ADJ adjustment, as necessary, to obtain result. Make sure indication does not drift after adjustment. (The dc amplifier voltage may drift for 30-60 minutes after actuation of POWER circuit breaker (step 16), causing OUTPUT meter to drift.) | CP | OUTPUT meter indicates zero (after dc amplifier has stabilized). |
| 30 | CP | Make sure multipurpose switch is set at PRESSURE; then check multipurpose meter for result. (If result is not obtained, the vacuum system may be leaking or may have become contaminated. Consult applicable Operation and Maintenance Manual (Bell & Howell Co). | CP | Multipurpose meter indicates 0.2 microns or less. |
| 31 | TPS | Check that adjustable pressure contact on TEST PORT PRESSURE meter is set for 30 microns or less; then turn VENT TEST switch to TEST position. | TPS | NO TEST light comes on. |
| 32 | CP | Move FILAMENT switch to ON. (If FILAMENT light does not come on, move FILAMENT switch to RESET, then to ON. If FILAMENT light still does not come on, the filament or other electronic components may have failed. Terminate test and refer to applicable Operation and Maintenance Manual for troubleshooting procedures (Bell & Howell Co). If 2nd result does not occur, check TEST PORT PRESSURE meter. If indicator has not contacted adjustable pressure contact, check system for leakage. Refer to applicable Operation and Maintenance Manual (Bell & Howell Co). | | (1) FILAMENT light comes on.<br><br>(2) NO TEST light goes off, and TEST light comes on. |

Figure 5-9. Operating Procedures for Leak Detector Set (Sheet 6 of 12)

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 33 | CP<br>LD | Move MULTIPLIER selector switch to X10 or X100; then very carefully turn throttle valve counterclockwise to obtain result. | CP | OUTPUT meter indication rises and stabilizes, and multipurpose meter does not exceed 0.2 microns. |
| 34 | CP | Record OUTPUT meter indication (to nearest scale division) as value C. Record X setting of MULTIPLIER selector switch as value D. | | |
| 35 | LD | Turn throttle valve handwheel fully clockwise. (Do not overtighten valve.) | LD | Throttle valve closed. |
| 36 | CP | Move MULTIPLIER selector switch to X1, and record OUTPUT meter indication (noise factor) as value E. | | |
| 37 | CP | Move FILAMENT switch to OFF. | CP<br>TPS | FILAMENT light goes off. TEST light goes off, and NO TEST light comes on. |
| 38 | TPS | Move VENT TEST switch to VENT. If desired, the standard leak may be removed. | TPS | NO TEST light goes off. |
| 39 | | Calculate temperature correction factor, value A, using figure 5-10 and formula $A_1 - A_2 = F$, as follows:<br><br>a. Subtract calibration temperature $A_2$ from ambient temperature $A_1$ to obtain temperature difference, F.<br><br>b. Using figure 5-10, determine temperature correction factor. Record correction factor as value A in figure 5-11. | | |
| 40 | | Calculate calibration sensitivity, S, using formula in figure 5-11. | | |

OPERATION

NOTE: Calibration procedure must be accomplished prior to step 41.

- Operation procedure is completed by performing steps 41 through 52.
- Refer to applicable Operations and Maintenance Manuals for alternate operation techniques.

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 41 | TPS | Make sure VENT TEST switch is at OFF. | | TEST and NO TEST lights are off. |

Figure 5-9. Operating Procedures for Leak Detector Set (Sheet 7 of 12)

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 42 | LD | Close protection throttle valve. Do not overtighten valve. | | |
| 43 | TPS | Replace standard leak (or other test item) with setup to be tested. | | |
| 44 | CP | Move FILAMENT switch to ON. (Make sure leak detector pressure is 0.2 microns or less.) | LD<br>TPS | FILAMENT light comes on. NO TEST light comes on. |
| 45 | TPS | Move VENT TEST switch to TEST. | | NO TEST light remains on. Then, when pressure indicator contacts adjustable pressure contact on TEST PORT PRESSURE meter, NO TEST light goes off and TEST light comes on. |
| 46 | LD<br>CP | Slowly open throttle valve. (Do not let leak detector pressure indication exceed 0.2 microns.) Use valve to throttle test gases as necessary. | LD | FILAMENT light remains on or goes out momentarily. |
| 47 | CP | Move MULTIPLIER selector switch as necessary, and allow indication of helium signal on OUTPUT meter to stabilize. | | |
| 48 | CP | Record numerical setting of MULTIPLIER selector switch as value F in figure 5-11. | | |
| 49 | CP | Record OUTPUT meter indication (to nearest scale division) as value G in figure 5-11. | | |
| 50 | TPS | Move VENT TEST switch to VENT. | TPS | TEST light goes off, and NO TEST light comes on. |
| 51 | | Calculate value X (amount of helium leak detected) for test setup using unknown-leak formula in figure 5-11. | | |
| 52 | TPS | If additional testing is required, repeat steps 42, 43, and 45 through 51. | | |

SECURING FOR LESS THAN 24 HOURS

CAUTION: An electrical power failure occurring during this standby condition necessitates a complete overhaul and cleaning of the vacuum system.

NOTE: Securing leak detector set for less than 24 hours is completed by performing steps 53 through 56.

| | | | | |
|---|---|---|---|---|
| 53 | LD | Close throttle valve (rotate counter-clockwise). Do not overtighten valve. | | |

Figure 5-9. Operating Procedures for Leak Detector Set (Sheet 8 of 12)

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 54 | TPS | Make sure VENT TEST switch is at VENT, and remove test setup. Provide a closure for test port (standard leak may be used to close port). | TPS | NO TEST light is on. |
| 55 | CP | Move FILAMENT switch to OFF. | LD<br>TPS | FILAMENT light goes off. NO TEST light goes off. |

WARNING: In the following step, eye protection and protective clothing must be worn by personnel handling liquid nitrogen containers, to prevent the liquid from contacting any part of the body. Human tissue will freeze upon contact causing serious injury.

| | | | | |
|---|---|---|---|---|
| 56 | LD | Fill cold trap with liquid nitrogen (MIL-P-27401) to a level no higher than 2 inches from top of cold trap bucket. | | |

SECURING FOR MORE THAN 24 HOURS

CAUTION: An electrical power failure occurring during this standby condition necessitates a complete overhaul and cleaning of the vacuum system.

NOTE: Securing leak detector set for more than 24 hours is completed by performing steps 57 through 67.

| | | | | |
|---|---|---|---|---|
| 57 | TPS | Make sure VENT TEST switch is at VENT, and remove test setup. Provide a closure for test port. | TPS | NO TEST light is on (if FILAMENT switch is on). |
| 58 | LD | Very slowly open throttle valve to fully open position (rotate counter-clockwise). | | |
| 59 | CP | Make sure FILAMENT switch is at OFF. | LD<br>TPS | FILAMENT light is off. NO TEST light is off. |
| 60 | CP | Release GAUGE circuit breaker by pressing release lever located below circuit breaker. | LD | GAUGE light goes off. |
| 61 | TPS | Move auxiliary pump switch to OFF. | | |
| 62 | LD | Open front cover of leak detector. Close Diatron isolation valve, and then pump isolation valve. | | |
| 63 | TPS | Press and hold TEST VALVE OVERRIDE switch for approximately 10 seconds. | | |

Figure 5-9. Operating Procedures for Leak Detector Set (Sheet 9 of 12)

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 64 | TPS | Move POWER switch (on test port station only) to OFF. | TPS | POWER light goes off. |

WARNING: In the following step, eye protection and protective clothing must be worn by personnel handling the cold trap bucket while the bucket contains liquid nitrogen. Human tissue will freeze upon contact with the liquid causing serious injury.

CAUTION: Extreme care must be taken when handling the cold trap bucket to prevent denting the very thin-walled barrel of the bucket.

NOTE: The following step vents the vacuum system.

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 65 | LD | Remove screws from cold trap flange, and carefully remove cold trap bucket. Empty bucket in a safe place. | | |

WARNING: The following procedure specifies toluene, which is flammable and must not be used near heat, sparks, or open flame. It is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 66 | LD | Allow bucket to rise to ambient temperature, then clean with toluene (Federal Specification TT-T-548). Wipe bucket dry with a clean, dry cloth, and reinstall bucket in vacuum manifold with O-ring and screws. | | |
| 67 | | If an electrical power failure is probable, perform a complete shutdown procedure for leak detector set as specified in steps 68 through 72. | | |

COMPLETE SHUTDOWN

NOTE: Shutdown of leak detector set is completed by performing steps 68 through 72.

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 68 | CP | Accomplish steps 57 through 67 if not already accomplished. | | |
| 69 | CP | Release DIFFUSION PUMP circuit breaker (by pressing release lever located below circuit breaker). | LD | DIFFUSION PUMP light goes off. |
| 70 | | Allow 15 minutes for diffusion pump to cool. | | |
| 71 | CP | Release POWER circuit breaker (by pressing release lever located below circuit breaker). | LD | All lights are off. |

Figure 5-9. Operating Procedures for Leak Detector Set (Sheet 10 of 12)

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 72 | LD | Make sure that diffusion pump is cool to touch; then slowly open pump and Diatron isolation valves. | | |

ADJUSTING DIATRON

NOTE: Perform this procedure only after maintenance of Diatron.

- Leak detector startup procedure (step 1 through 24) must be performed prior to adjusting Diatron.

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 73 | LD | Perform steps 1 through 24. | | |
| 74 | CP | Move multipurpose switch to ACCELERATOR. | | |
| 75 | FP | Tilt control panel forward, and adjust ACCELERATOR VOLTAGE ADJ. HELIUM for maximum result. | CP | Multipurpose meter indicates 60-80 volts. |
| 76 | CP | Move multipurpose switch to IONIZING CURRENT. | | |
| 77 | CP | Move MULTIPLIER selector switch to X500. | | |
| 78 | EP | Move HIGH IONIZING CURRENT adjustment, as necessary, to obtain result. | CP | Multipurpose meter indicates midscale mark. |
| 79 | CP | Record OUTPUT meter indication (to nearest division mark). | | |
| 80 | CP | Move MULTIPLIER selector switch to X1000. | | |
| 81 | EP | Turn LOW IONIZING CURRENT adjustment, as necessary, to obtain result. | CP | OUTPUT meter indication is one-half of value recorded in step 79. |
| 82 | CP | Move FILAMENT switch to OFF | | |
| 83 | EP | Connect 0-500 microampere meter to ACCELERATOR CURRENT test jack. (Use 3-circuit phone plug, Type 267 (Switchcraft), or equivalent.) Make sure that positive meter terminal is connected to insulated ring terminal of plug. | | |

Figure 5-9. Operating Procedures for Leak Detector Set (Sheet 11 of 12)

| Step | Loc | Operation | Loc | Result |
|---|---|---|---|---|
| 84 | CP | Move FILAMENT switch to ON. | CP | FILAMENT light comes on |
| 85 | TPS | Make sure that VENT TEST switch is in TEST position and that TEST light is on. | | |
| 86 | LD | Make sure that THROTTLE valve is not closed. | | |
| 87 | LD | Open front cover of leak detector unit, loosen and rotate Diatron magnet as necessary to obtain result. Then secure Diatron magnet, and close cover. | CP<br>EQP | OUTPUT meter indication rises to a maximum value as 0-500 microampere meter indicates a minimum value. See figure 5-12. |
| 88 | CP | Move FILAMENT switch to OFF. | CP | FILAMENT light goes off. |

NOTE: Calibration procedure (steps 25 through 40) must be accomplished prior to further operation of leak detector set.

Figure 5-9. Operating Procedures for Leak Detector Set (Sheet 12 of 12)

c. Lift out precision tube.

d. Allow piston to slide to end of precision tube.

e. Slowly pull piston from precision tube. Mercury seal will flow off piston.

f. Remove screw from piston, and drain remaining mercury from piston.

g. Install screw in piston.

h. Insert piston in precision tube.

i. Insert tube in flowrate tester frame, placing end of tube on bottom rubber seat first.

j. Slowly tighten stem nut and attached seal plug until contact is made with top of precision tube.

k. Make sure tube is centered on rubber seats.

l. Tighten stem nut and attached seal plug until a compression seal is obtained.

m. Install front and rear panels with four screws in each.

5-21. TESTING FLOWRATE TESTER AND STOPWATCH. Testing the flowrate tester and stopwatch consists of flowing gaseous nitrogen into the flowmeter and testing stopwatch operation. Test flowrate tester and stopwatch as follows:

a. Attach a hand valve to flowmeter outlet, and make sure hand valve is open.

CAUTION

If the flowmeter vent is not open, excessive pressure can build up in the tester tube, causing damage to the tester.

b. Make sure vent at top rear of flowmeter is open.

c. Level tester with base adjusting screw.

d. Make sure that mercury seal is a continuous ring in piston groove.

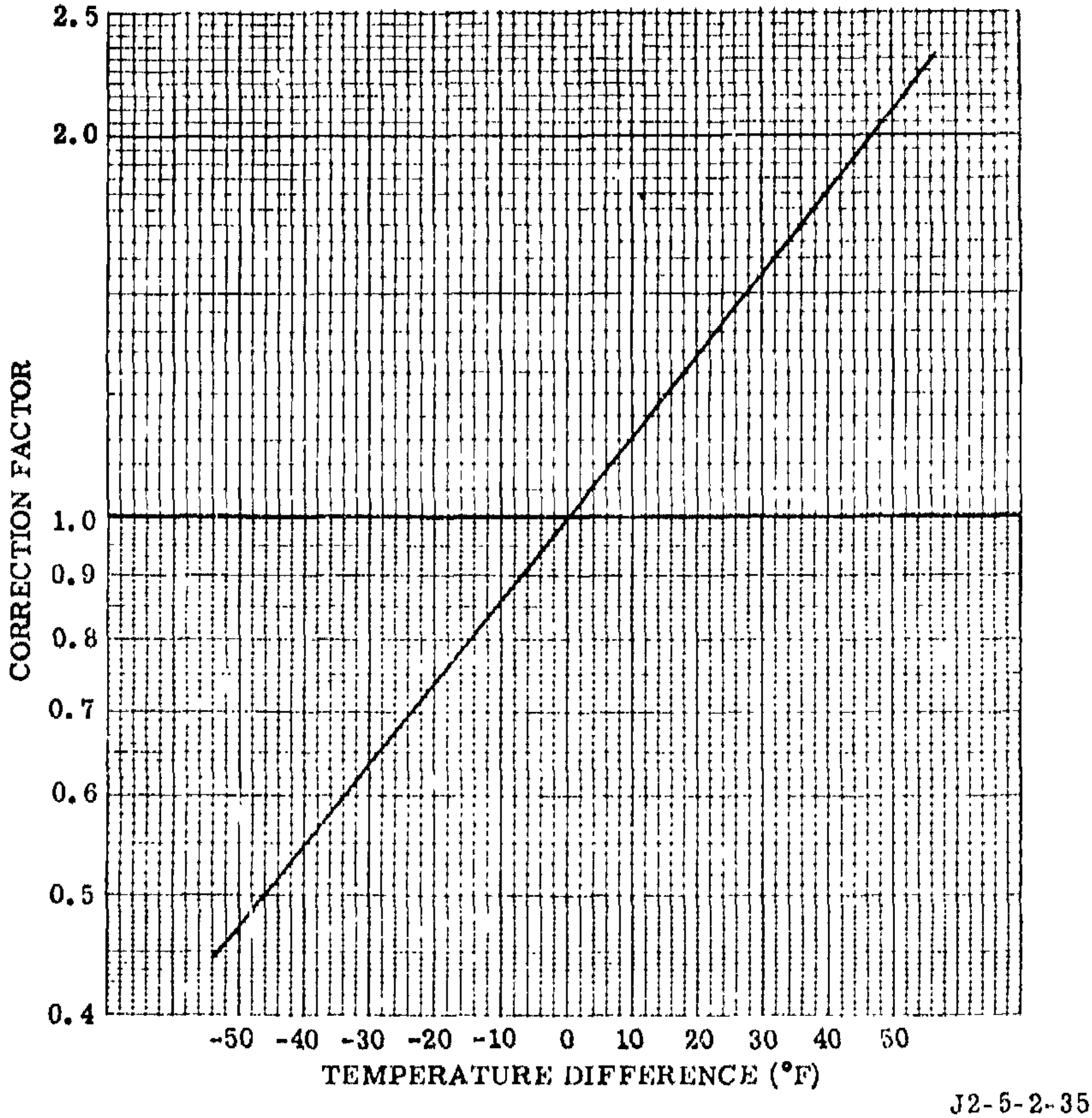



Figure 5-10. Leak Detector Temperature Correction Factor Chart

e. Flow 20-100 cc/m of gaseous nitrogen (MIL-P-27401) into tester inlet.

CAUTION

If the piston rises to top of tube, the mercury seal can be blown out of the groove.

f. Adjust hand valve at tester outlet to allow piston to rise smoothly past top of graduated scale.

g. Open hand valve at outlet until piston descends to bottom of tester.

Record calibration values:

| | |
|---|---|
| Ambient temperature | $A_1$ = ____________ |
| Calibration temperature | $A_2$ = ____________ |
| Temperature correction factor | A = ____________ |
| Standard leak leak rate | B = ____________ |
| OUTPUT meter (nearest scale division) | C = ____________ |
| MULTIPLIER (multiplication factor) | D = ____________ |
| Noise factor (zero reference) | E = ____________ |
| Leak detector sensitivity factor | S = (to be calculated) |

Calibration formula:

$$S = \frac{A \times B}{(C \times D) - E}$$

Where S = Sensitivity in atmospheric cubic centimeters per second per scale division (atm cc/sec/div).

Example:

Assume $A = 0.9$, $B = 3 \times 10^{-7}$, $C = 90$, $D = 10$, and $E = 3$.

Then $S = \frac{0.9 \times (3 \times 10^{-7})}{(90 \times 10) - 3}$, $S = \frac{0.9 \times 0.000\,0003}{(900) - 3}$,

$S = \frac{0.000\,000\,27}{897}$, $S = 0.\,000\,000\,000\,301$

or $S = 3.01 \times 10^{-10}$, for this example.

Unknown-leak formula:

$$X = F \times G \times S$$

| | |
|---|---|
| MULTIPLIER switch setting | F = ____________ |
| OUTPUT meter indication | G = ____________ |
| Atmospheric cubic centimeters per second | X = (to be calculated) |

Figure 5-11. Leak Detector Calibration and Unknown-Leak Formula

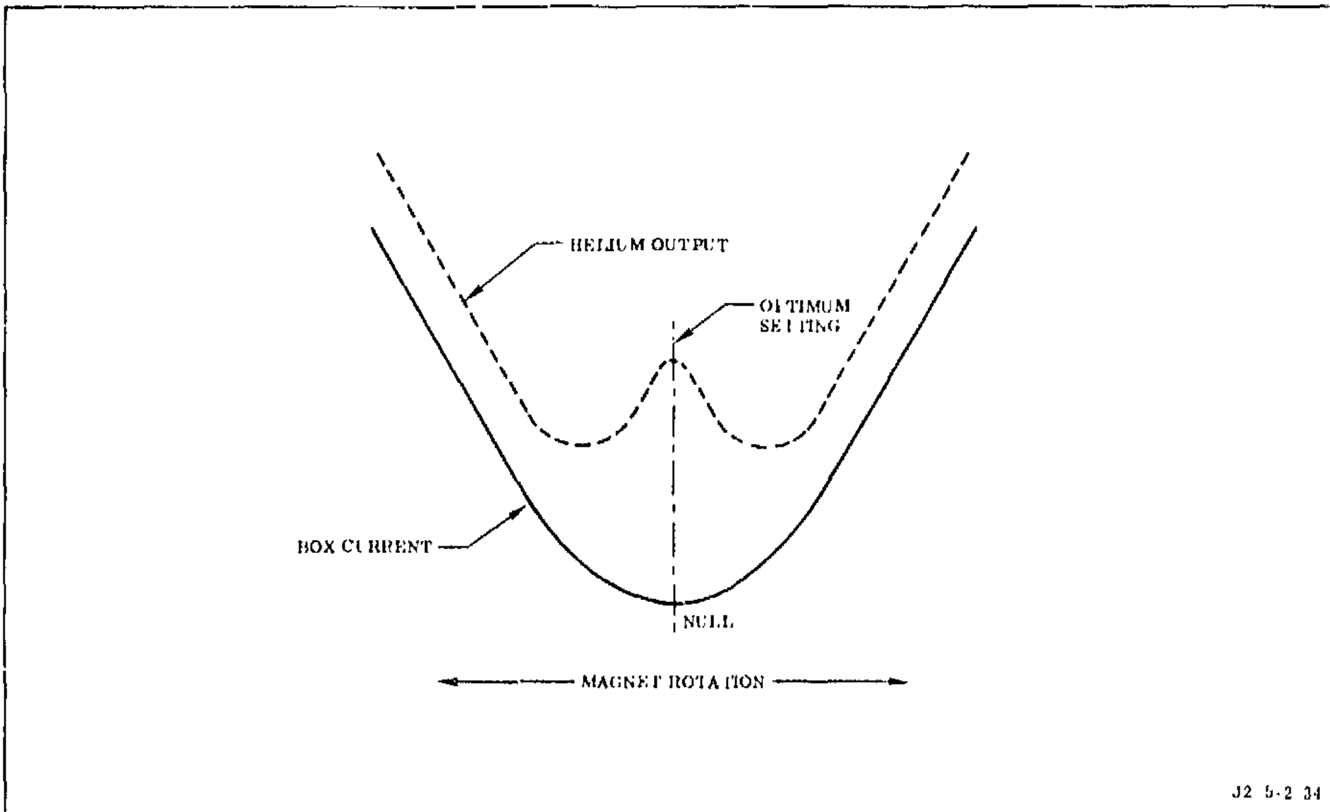



Figure 5-12. Leak Detector Diatron Magnet Alinement

h. Wind stopwatch and operate for 30 minutes. Momentarily press crown to start, stop, and reset stopwatch.

5-22. CHECKING ACCURACY OF STOPWATCH. The stopwatch must be within an accuracy of ±0.4 second in 30 minutes, compared with an instrument having an accuracy of ±0.2 second in 30 minutes. If stopwatch is not within accuracy specified, replace with one of known accuracy.

5-23. MAINTENANCE OF PORTABLE ENVIRONMENTAL TEST CHAMBER.

5-24. Test chamber maintenance consists of cleaning and preparation for storing or shipment. Clean the test chamber by handwiping. (Refer to R-3825-5, Volume I.) When storing or preparing test chamber for shipment, cap all open ports, and install and secure cover. Store test chamber in an enclosed polyethylene bag having a minimum thickness of 0.040 inch.

5-25. MAINTENANCE OF HIGH-VOLTAGE LEAKAGE TESTER.

WARNING

Compressed gas must not be used for drying or cleaning unless effective chip guarding is used and personal protection equipment is worn.

5-26. Maintenance consists of cleaning the tester and calibration-checking the tester instruments. Clean external surfaces of tester by handwiping. (Refer to R-3825-5, Volume I.) Clean interior with a soft-bristle brush or low-pressure (less than 30 psig) gaseous nitrogen (MIL-P-27401).

5-27. TESTING HIGH-VOLTAGE LEAKAGE TESTER.

a. Obtain the following test equipment:

(1) Eleven 100K-ohm, one-watt resistors GBT1 (International Resistance Co), or equivalent

(2) One 0.001-$\mu$f and two 0.002-$\mu$f capacitors, MAL series (General Electric), or equivalent

b. Disconnect test leads from tester.

c. Move COMPENSATION control to NONE.

WARNING

Testing on a metal surface can result in electrical shock to personnel.

d. Connect tester to a 115-vac, 60-cycle outlet. Press and hold POWER switch. POWER light comes on.

e. Turn VOLTS control clockwise until AC VOLTS voltmeter indicates 1,500 ±75 volts.

f. Repeat step e until meter indicates 2,500 vac.

g. Turn VOLTS control fully counterclockwise, and release POWER switch. POWER light goes off. AC VOLTS voltmeter indicates zero.

h. Connect test leads to tester.

WARNING

If test leads are not kept separated, damage to equipment and injury to personnel can result.

i. Press and hold POWER switch. POWER light comes on. Turn VOLTS control clockwise until AC VOLTS voltmeter indicates 1,000 volts.

j. Release POWER switch. POWER light goes off, and AC VOLTS voltmeter indicates zero.

k. Connect test leads to 11 resistors in series. Press and hold POWER switch. POWER light comes on, and AC MICROAMPS meter indicates 900 ±90 microamps.

l. Release POWER switch. POWER light goes off and meters indicate zero. Turn VOLTS control fully counterclockwise, and disconnect test leads from resistors.

m. Connect 0.001-$\mu$f capacitor between test leads. Press and hold POWER switch. POWER light comes on.

n. Turn VOLTS control until microamps scale indicates leakage. Turn COMPENSATION control clockwise. AC MICROAMPS meter indicates a decrease in leakage. Release POWER switch.

o. Repeat steps m and n, using 0.002-$\mu$f capacitor, 0.001- and 0.002-$\mu$f capacitors connected in parallel, then both 0.002-$\mu$f capacitors connected in parallel.

p. Connect a resistor to one lead of tester, and place other lead to create a 0.020 to 0.025 inch gap from resistor lead. Press and hold POWER switch, and turn VOLTS control clockwise until arc occurs at gap. Speaker signals.

NOTE

It may be necessary to decrease gap to produce an arc.

q. Release POWER switch. POWER light goes off, and meters indicate zero.

5-28. CHECKING ACCURACY OF HIGH-VOLTAGE LEAKAGE TESTER. The tester meters must be within an accuracy of 3 percent of full scale, compared with an instrument having an accuracy of 1/2 percent of full scale. If voltmeter or microammeter are not within accuracy specified, replace meter(s) with meter within specified accuracy.

5-29. MAINTENANCE AND REPAIR OF TEST KITS.

5-30. Maintenance of the test kits consists of repairing, cleaning, testing, calibrating, and storing.

5-31. REPAIRING TEST KITS. Test kit repair consists of replacing threaded inserts on test plates and lubricating fittings during component assembly. (Refer to R-3825-5, Volume I, for removing and installing threaded inserts and lubricating procedures.)

5-32. CLEANING TEST KITS. Components of the test kits that may be connected to an engine propellant or pneumatic system must be cleaned, packaged, and certified clean for the applicable system in which the components are to be used. (Refer to R-3825-5, Volume I, for cleaning procedure applicable to the component.)

5-33. TESTING SPARK IGNITER ADAPTER SET DC HYPOT. Testing procedures for the DC Hypot in the spark igniter dielectric test adapter set are listed in figure 5-13.

| Step | Operation | Result |
|---|---|---|
| 1 | Obtain the following test equipment:<br>a. Five 100-K ohm, one-watt resistors<br>b. Multimeter, Model 630A (Simpson), or equivalent<br>c. Vacuum tube voltmeter, Model 410B (Hewlett Packard), or equivalent<br>d. Resistive voltage multiplier Model 459A (Hewlett Packard), or equivalent | |
| 2 | Turn off POWER switch and HV lever. Make sure VOLTAGE control is fully counterclockwise. | |
| 3 | Connect jumper from SAFETY GROUND stud to ground. | |

WARNING: Operating the DC Hypot without a ground can result in serious injury or death.

| Step | Operation | Result |
|---|---|---|
| 4 | Connect resistors in series to high-voltage output terminal, then in series with multimeter to METERED RETURN terminal. | |
| 5 | Connect DC Hypot to 115-vac facility outlet. | |
| 6 | Turn on POWER switch. | POWER ON light comes on. |
| 7 | Move MICROAMPS selector switch to 2, 500. | |
| 8 | Move HV lever to ON. | HV light comes on. |
| 9 | Slowly turn VOLTAGE control clockwise. | a. Breaker trips at 1, 500 ±150 volts.<br>b. Multimeter indicates zero. |
| 10 | Turn VOLTAGE control fully counterclockwise, and move MICROAMPS selector switch to 50. | |
| 11 | Turn VOLTAGE control until MICROAMPS meter indicates 50. | Multimeter indicates 49-51 microamps. |
| 12 | Turn MICROAMPS selector to 250. | |
| 13 | Turn VOLTAGE control until MICROAMPS meter indicates 250. | Multimeter indicates 245-255 microamps. |
| 14 | Move MICROAMPS selector switch to 2, 500. | |

Figure 5-13. Testing DC Hypot (Sheet 1 of 2)

| Step | Operation | Result |
|---|---|---|
| 15 | Turn VOLTAGE control until MICROAMPS meter indicates each of the following: | Multimeter indicates: |
| | a. 1,000 | 950-1,050 microamps |
| | b. 1,500 | 1,450-1,550 microamps |
| | c. 2,000 | 1,950-2,050 microamps |
| | d. 2,500 | 2,450-2,550 microamps |
| 16 | Turn VOLTAGE control fully counterclockwise. | Multimeter indicates zero. |
| 17 | Turn off HV lever, then POWER switch. | HV and POWER ON lights go off. |
| 18 | Remove test equipment, and connect probe and voltage multiplier to METERED RETURN terminal. | |
| 19 | Turn on POWER switch and HV lever. | POWER ON and HV lights come on. |
| 20 | Turn VOLTAGE control until KILOVOLT meter indicates each of the following: | Multiplier indicates: |
| | a. 5,000 | 29-71 volts |
| | b. 10,000 | 79-121 volts |
| | c. 15,000 | 129-171 volts |
| | d. 20,000 | 179-221 volts |
| | e. 25,000 | 229-271 volts |
| | f. 30,000 | 279-321 volts |

Figure 5-13. Testing DC Hypot (Sheet 2 of 2)

5-34. CHECKING ACCURACY OF SPARK IGNITER ADAPTER SET DC HYPOT. The DC Hypot contained in the spark igniter adapter set (dielectric test) must be checked for accuracy every 6 months. The kilovoltmeter and microammeter must be checked for an accuracy of 3 percent of full scale, compared to a laboratory standard with an accuracy of 1/2 percent of full scale. If specified accuracies are not obtained, the meter being checked must be replaced with a meter within the specified accuracy.

5-35. STORING TEST KITS. Test kits are stored in the components adapter set cabinet. The containers listed in figure 5-14 may be used for long-term storage.

| Test Kit/Test Fixture Part Number | Container |
|---|---|
| 9021876 | - - - |
| 9021884 | RX23175-KKA-2 |
| 9021885 | RX23175-JJA-2 |
| 9021887 | RX27010-21 |
| 9022189 | RX27010-11 |
| 9022447 | RX23175-EBB-1 |
| 9022535 | RX23175-CCC-1 |
| 9022529 | RX23175-CCB-1 |

Figure 5-14. Test Kit Containers

5-36. MAINTENANCE OF ACCESSORIES.

5-37. Maintenance of the accessories consists of cleaning and testing accessories and replacing filter elements. Lubricate filter packings and threads during assembly. Refer to R-3825-5, Volume I, for lubricating procedures.

5-38. CLEANING ACCESSORIES. Accessories that may be connected to an engine propellant or pneumatic system must be cleaned, packaged, and certified clean for the applicable system in which the accessories are to be used. Refer to R-3825-5, Volume I, for cleaning procedure applicable to the accessory.

5-39. TESTING ACCESSORIES.

5-40. Testing accessories consists of hand valve leak tests, a temperature transducer resistance test, a manifold function test, an electrical cable continuity test, and a hose proof-pressure test.

5-41. TESTING HAND VALVES. Pneumatic Test Console G3107 may be used to test hand valves and cryogenic hand valves. Refer to R-3825-5, Volume I, to prepare console for pneumatic use. Test valves listed in figure 5-4 as follows:

a. Apply 6,000 psig gaseous nitrogen (MIL-P-24701) to IN port of hand valve with valve closed. Leakage is not allowable at OUT port or stem.

b. Vent pressure, and apply 6,000 psig to OUT port. Leakage is not allowable at IN port or stem.

c. Vent pressure, plug OUT port, and open valve.

d. Apply 6,000 psig to hand valve. External leakage is not allowable.

5-42. TESTING CONNECTION VALVE. Pneumatic Test Console G3107 may be used to test the connection valve. Refer to R-3825-5, Volume I, to prepare console for pneumatic use. Plug outlet of connection valve, and apply 1,000 psig gaseous nitrogen (MIL-P-27401) through a flowmeter to valve inlet. Maximum allowable leakage is 50 scim.

5-43. TESTING TEMPERATURE TRANSDUCER. Test temperature transducer by measuring resistance between pins B and C on transducer electrical connector. Resistance must be 500 ±5 ohms at a temperature of 70° to 78° F.

5-44. TESTING MANIFOLD. Pneumatic Test Console G3107 may be used to test the manifold. Refer to R-3825-5, Volume I, to prepare console for electrical use. Patch the console electrical control panel as shown in figure 5-15. Connect test cable 103317 to manifold and test cell electrical outlet. Test manifold as follows:

a. Cap COMM ports with pressure caps.

b. Secure valve to prevent movement during flow test.

c. Apply 1,500 psig gaseous nitrogen (MIL-P-27401) to INLET N.C. port. Leakage is not allowable at VENT N.C. ports.

NOTE

Leakage is defined as any leakage 2.0 cc/hr or greater.

d. Apply 24 ±4 vdc to solenoids, and allow system to stabilize. Leakage is not allowable at VENT N.C. port.

e. Decrease pressure to zero, and remove electrical power. Pressure in valve vents.

f. Remove pressure caps from COMM ports.

g. Apply 30 psig to INLET N.C. port and 24 ±4 vdc to one solenoid. Flow must be evident at COMM port of valve. Remove 24 ±4 vdc. Flow stops.

h. Apply 24 ±4 vdc to remaining solenoid. Flow must be evident at COMM port of valve. Remove 24 ±4 vdc. Flow stops.

5-45. TESTING ELECTRICAL CABLES. Test the cables (figure 5-4) by performing a continuity check. The cables are listed in figure 5-16 with the connector pins and interconnecting wires.

| Patch-Cord Connections | Remarks |
|---|---|
| A1-10D to A1-1A | Supplies 28 vdc to switch-light number 1. |
| A1-1C to A1-1I | Connects switch-light number 1 to connector P807. |
| A1-1H to A1-9F | Provides return from connector P807 |
| A1-10E to A1-2A | Supplies 28 vdc to switch-light number 2. |
| A1-2C to A1-2I | Connects switch-light number 2 to connector P808. |
| A1-2H to A1-9D | Provides return from connector P808. |

Figure 5-15. Patch-Cord Connections for Testing Manifold

| From Connector and Pin | To Connector and Pin |
|---|---|
| **9026540** | |
| P25E-e | P904-A |
| P25E-$\overline{f}$ | P904-B |
| P25E-$\overline{h}$ | P904-C |
| P25E-$\overline{i}$ | P904-D |
| P25E-$\overline{k}$ | P904-E |
| P25E-$\underline{m}$ | P904-F |
| **9026541** | |
| P26D-B | P806-A |
| P26D-F | P806-B |
| P26D-G | P806-C |
| **9026542** | |
| P26C-F | P802-A |
| P26C-G | P802-B |
| P26C-H | P802-C |
| P26C-J | P802-D |
| P26C-K | P803-A |
| P26C-L | P803-B |
| P26C-M | P803-C |
| P26C-N | P803-D |
| P26C-P | P804-A |
| P26C-R | P804-B |
| P26C-S | P804-C |
| P26C-T | P804-D |
| P26C-U | P805-A |
| P26C-V | P805-B |
| P26C-W | P805-C |
| P26C-X | P805-D |
| **9026543** | |
| P26B-B | P801-A |
| P26B-F | P801-B |
| P26B-G | P801-C |
| P26B-H | P801-D |
| P26B-J | P801-E |
| **9026544** | |
| P25D-N | P903-A |
| P25D-P | P903-B |
| **9026545** | |
| P25C-Y | P902-A |
| P25C-W | P902-B |
| P25C-V | P902-C |
| P25C-c | P902-D |
| P25C-$\overline{b}$ | P902-E |
| P25C-$\overline{Z}$ | P902-F |
| P25C-HH | P902-G |
| **9026546** | |
| P25B-V | P901-A |
| P25B-W | P901-B |
| P25B-Y | P901-C |
| P25B-Z | P901-D |
| P25B-b | P901-E |
| P25B-$\overline{c}$ | P901-F |
| P25B-$\overline{H}$H | P901-G |
| **9026547** | |
| P26A-C | P800-A |
| P26A-D | P800-B |
| P26A-E | P800-C |
| **9026548** | |
| P25A-A | P900-C |
| P25A-B | P900-D |
| P25A-C (a) | |
| P25A-D | P900-E |
| P25A-E | P900-F |
| P25A-F (a) | |
| P25A-G | P900-H |
| P25A-H | P900-J |
| P25A-J (a) | |

(a) Pin connected to shield ties

Figure 5-16. Electrical Cable Wire List (Sheet 1 of 2)

| From Connector and Pin | To Connector and Pin |
|---|---|
| **9026548 (cont)** | |
| P25A-K | P900-K |
| P25A-L | P900-L |
| P25A-M[a] | |
| P25A-S | P900-P |
| P25A-T | P900-R |
| P25A-U[a] | P900-T[a] |
| **9026549** | |
| P25F-b | P905-A |
| P25F-$\bar{c}$ | P905-B |
| P25F-$\bar{d}$[a] | |
| P25F-$\bar{e}$ | P905-C |
| P25F-$\bar{f}$ | P905-D |
| P25F-$\bar{g}$[a] | |

| From Connector and Pin | To Connector and Pin |
|---|---|
| **9026538** | |
| P26E-A | P807-A |
| P26E-B | P807-B |
| P26E-C | P808-A |
| P26E-E | P808-B |
| **9026539** | |
| P26F-P | P809-A |
| P26F-M | P809-B |
| P26F-N | P809-C |

(a) Pin connected to shield ties

Figure 5-16. Electrical Cable Wire List (Sheet 2 of 2)

5-46. PROOF-PRESSURE-TESTING ADAPTER SET HOSES. Proof-pressure-test hoses hydrostatically or with gaseous nitrogen (MIL-P-27401) to the pressure shown in figure 5-17. Pressurize hose for 2 minutes, vent pressure, and repeat cycle 4 times. Permanent damage or deformation is not allowable. Hydrostatically proof-tested hoses must be cleaned prior to use. (Refer to paragraph 5-38.)

WARNING

Safety regulations must be observed when proof-pressure-testing. Proof pressure can burst a defective hose, causing injury or death.

| Hose Part Number | Proof-Test Pressure |
|---|---|
| 19-9014938-32 | 10,000 ±200 psig |
| 19-9014938-33 | 6,000 ±120 psig |
| 19-9014938-34 | 6,000 ±120 psig |
| 19-9014938-35 | 6,000 ±120 psig |
| 19-9021927-3 | 3,000 ±60 psig |
| 19-9021927-4 | 3,000 ±60 psig |
| 19-9021927-5 | 3,000 ±60 psig |
| 19-9021904-2[a] | 6,500 ±130 psig |

(a) In test set 9021901

Figures 5-17. Proof-Pressure Test Requirements

5-47. TESTING PATCH-CORDS. Testing patch-cords consists of checking continuity and measuring resistance. Wheatstone bridge, Model 5305 (Leeds and Northrup Co), or equivalent, may be used to measure patch-cord resistance.

a. Check for continuity between pins A and B of patch-cord 3088-10.

b. Measure resistance across the following patch-cords:

| Patch-Cord Part Number | Required Resistance (Ohms) |
|---|---|
| 3088-7 | 270-330 |
| 3088-8 | 460-560 |
| 3088-9 | 90-110 |
| 3088-11 | 9-11 |

Pages 5-45 thru 5-64 deleted.

# SECTION VI

# LIQUID NITROGEN SERVICE UNIT 2425000

## WARNING

LIQUID NITROGEN SERVICE UNIT 2425000 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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## TABLE OF CONTENTS

## 6-1. DESCRIPTION AND LEADING PARTICULARS OF LIQUID NITROGEN SERVICE UNIT.

## 6-2. DESCRIPTION OF LIQUID NITROGEN SERVICE UNIT.

6-3. The liquid nitrogen service unit (figure 6-1) is a mobile storage tank used to transport, store, and supply liquid nitrogen to the components test console. The service unit consists of a 105 gallon vacuum-jacketed storage tank mounted on a trailer, a valve and instrument compartment at the rear of the storage tank, and a transfer hose. The storage tank is comprised of an inner and outer shell with a

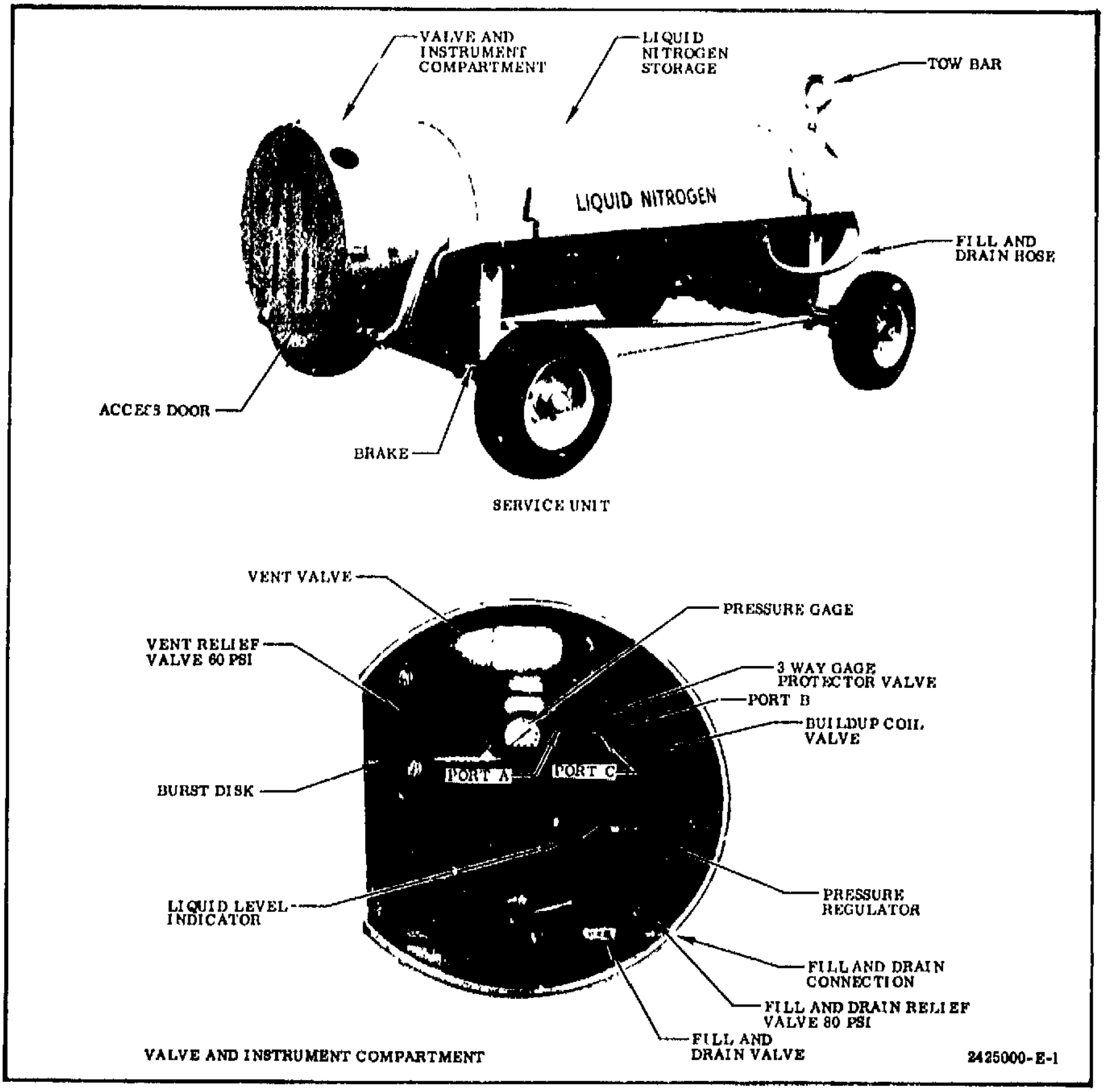


Figure 6-1. Liquid Nitrogen Service Unit

vacuum space between the shells and is designed to hold 100 gallons of liquid nitrogen, allowing a 5 gallon vapor space. The valve and instrument compartment contain the gages and valves used to indicate liquid level, build pressure, and transfer liquid nitrogen. Relief valves and burst diaphragms protect the system against overpressurization. A pressure buildup is incorporated into the system to pressurize the tank when transferring liquid. A storage rack is provided along the side of the tank for the flexible transfer hose. The four wheel trailer has a tow bar, steerable front wheels, pneumatic tires, and a brake mounted on one rear wheel. Maximum towing speed is 5 miles per hour. A safety chain must be used between service unit and towing vehicle. Liquid nitrogen is transferred into the service unit by connecting the transfer hose to a liquid nitrogen source, opening fill and drain valve, opening vent valve, and allowing liquid nitrogen to flow into the service unit. The amount of liquid nitrogen in the service unit is indicated on the liquid level gage. Liquid nitrogen is transferred from the service unit by connecting the transfer hose to the receiving unit, closing the vent valve, and opening the buildup coil valve. Liquid nitrogen flows through the buildup coil, vaporizes, and creates a pressure which is then routed to apply a pressure head on the liquid nitrogen in the tank. Pressure in the system is indicated on the pressure gage. When the desired transfer pressure is reached, the fill and drain valve is opened and transfer of liquid is started. (Refer to figure 6-2.)

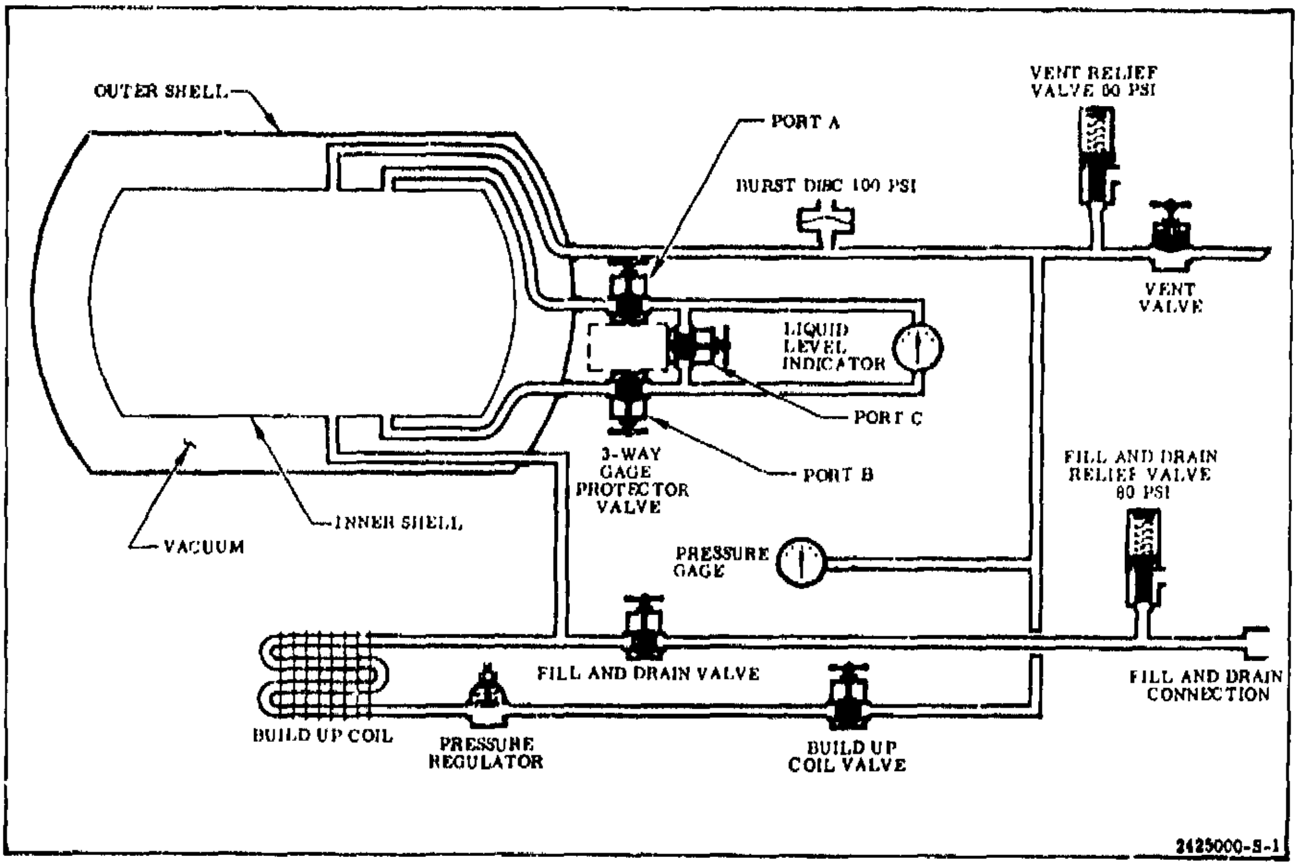


Figure 6-2. Liquid Nitrogen Service Unit Schematic

## 6-4. LEADING PARTICULARS FOR LIQUID NITROGEN SERVICE UNIT.

6-5. Leading particulars for the service unit are listed in figure 6-3.

| | Inches | | |
|---|---|---|---|
| Length (Tow Bar Stowed) | 87 | Weight (Empty) | 795 pounds |
| Length (Tow Bar Extended) | 122 | Tire Size | 4.00 X 8, 6 ply |
| | | Tire Pressure | 100 psi |
| Width | 50 | Towing Speed | 5 mph |
| Height (Tow Bar Stowed) | 43.5 | Steering Angle | 30 degrees |
| Height (Tow Bar Extended) | 34.5 | Storage Tank Capacity | |
| | | Liquid | 100 gallons |
| Wheelbase | 56.5 | Vapor Space | 5 gallons |
| Tow Bar Length | 36 | System Operating Pressure | 50 psi |

Figure 6-3. Leading Particulars for Liquid Nitrogen Service Unit

## 6-6. MAINTENANCE OF LIQUID NITROGEN SERVICE UNIT.

6-7. The maintenance tasks required to ensure operation of the service unit are listed in figure 6-4, which lists the tasks to be performed, indicates when the task is to be performed, and references the data to support the tasks.

| Requirement | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect service unit for scratches and chipped paint. | X | | | | Paint exposed surfaces. Refer to paragraph 6-20. |
| Inspect for open vent ports and lines; inspect open vent ports and lines for contamination. | X | X | | | Replace contaminated service unit. |
| Inspect open transfer hose for contamination. | X | X | | | When contaminated, clean hose. Refer to R-3825-5, Volume I. |
| Inspect tires for proper inflation. | X | X | | | Refer to figure 6-3. |
| Inspect gages for broken glass. | X | X | | | Replace as required. |
| Inspect painted surfaces for corrosion. | X | | | | Clean and paint surfaces. Refer to paragraph 6-20. |
| Inspect buildup coil for damage. | X | | | | Replace service unit. |
| Inspect storage tank for pressurization. | X | | X | | Every 30 days in storage. Pressure gage indicates 1-5 psig. |
| Inspect brakes for positive braking action. | X | X | | | With brake lever actuated, service unit must be immobile. If service unit remains mobile, repair brake. |
| Inspect steering gear for binding during movement. | X | X | | | Lubricate steering gear. Refer to paragraph 6-18. |

Figure 6-4. Maintenance Requirements for Liquid Nitrogen Service Unit (Sheet 1 of 3)

| Requirement | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect valve compartment for moisture or accumulation of water. | | | | X | Subsequent to use as frost thaws from compartment components or whenever unit is stored outdoors. Remove moisture and water. Clean valve compartment. Refer to R-3825-5, Volume I. |
| Clean service unit. | | | | X | Prior to storage. Refer to R-3825-5, Volume I. |
| Lubricate trailer steering gear. | | | | X | Every 30 days. Refer to paragraph 6-18. |
| Lubricate trailer wheel bearings. | | | | X | Every 6 months. Hand-pack bearings. Refer to paragraph 6-18. |
| Leak- and function-test. | | | | X | Prior to initial use. Refer to paragraph 6-8. |
| Proof-test transfer hose. | | | | X | Every 6 months. Disconnect transfer hose from service unit, pressurize hose to 100 psig with gaseous nitrogen (MIL-P-27401) (paragraph 1-42), and hold for 2 minutes. Vent and repeat 4 additional times. |
| Test relief valves. | | | | X | Every 6 months. Refer to paragraphs 6-13 and 6-15. |
| Check calibration of pressure gage. | | | | X | Every 6 months. Refer to paragraph 6-22. |
| Prepare service unit for storage. | | | | X | Whenever storage tank is not in use. Refer to paragraph 6-24. |

Figure 6-4. Maintenance Requirements for Liquid Nitrogen Service Unit (Sheet 2 of 3)

| Requirement | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Heat leak-test. | | | | X | Every 6 months. Refer to paragraph 6-14. |
| Prepare service unit for shipping. | | | | X | Prior to shipping. Refer to paragraph 6-24. |

Figure 6-4. Maintenance Requirements for Liquid Nitrogen Service Unit (Sheet 3 of 3)

6-8. LEAK- AND FUNCTION-TESTING LIQUID NITROGEN SERVICE UNIT.

6-9. Leak- and function-testing consists of filling the service unit, leak-testing, heat leak-testing, and setting relief valves. (Refer to figures 6-1 and 6-2.)

6-10. TEST EQUIPMENT. Test equipment used to leak-test service unit is listed in figure 6-5.

| Part Number | Nomenclature | Use |
|---|---|---|
| MIL-P-27401 | Liquid nitrogen | Fill and pressurize service unit |
| MIL-P-27401 | Gaseous nitrogen | Test relief valve |
| MSFC-SPEC-384 | Leak-test compound | Leak-test connections |
| | Pressure gage, 0-100 psi | Indicate pressure |
| | Flowmeter, 10-350 cim | Measure leakage |
| | Hand vent valve | Vent transfer hose |
| | Asbestos Gloves | Personnel protection |
| | Face shield | Personnel protection |

Figure 6-5. Test Equipment

6-11. FILLING LIQUID NITROGEN SERVICE UNIT.

a. Open vent valve on service unit and vent storage tank. Pressure gage shall indicate zero psig.

b. Connect a LOX-clean transfer hose and hand vent valve to facility liquid nitrogen supply. (Refer to section I for cleaning requirements.)

WARNING

Eye protection and protective clothing must be worn by personnel handling liquid nitrogen to prevent the liquid from coming in contact with any part of the body. Human tissue will freeze upon contact, causing serious injury.

c. Fill service unit with 50 gallons of liquid nitrogen. Refer to placard on service unit access door.

WARNING

Do not loosen or tighten connections while system is pressurized or at cryogenic temperature since serious injury to personnel and damage to equipment may result.

CAUTION

When operating the 3-way gage protector valve, port C must be open prior to the opening or closing of ports A and B. The opening or closing of either port A or port B while port C remains closed can result in damage to the liquid-level indicator.

6-12. LEAK TESTING.

a. Prepare service unit for test. (Refer to paragraph 6-11.)

b. Pressurize system by closing vent valve and opening buildup coil valve.

NOTE

Tank pressure, controlled by the pressure regulator, will stabilize at 50 psig as indicated on the pressure gage.

c. Open vent valve, as necessary, to relieve any pressure in excess of 50 psig.

d. Apply leak-test compound (MSFC-SPEC-384) to all connections. No leakage is allowable.

e. Open vent valve and allow pressure to vent.

f. If no additional tests are to be performed, secure service unit. (Refer to paragraph 6-16.)

6-13. TESTING VENT RELIEF VALVE.

a. Prepare service unit for test. (Refer to paragraph 6-11.)

b. Pressurize system by closing vent valve and opening buildup coil valve.

NOTE

Tank pressure, controlled by the pressure regulator, will stabilize at 50 psig as indicated on the pressure gage.

c. Loosen lock nut on pressure regulator and turn adjusting screw clockwise. Adjust pressure regulator to build pressure until relief valve vents at 60 ±5 psig.

d. Open vent valve as necessary to control pressure in excess of 65 psig.

e. Open vent valve and allow pressure to vent.

f. Adjust relief valve as required, then repeat steps c through e.

g. Loosen lock nut on pressure regulator and turn adjusting screw counter-clockwise. Set pressure regulator to 50 psig. Tighten lock nut.

h. If no additional tests are to be performed secure service unit. (Refer to paragraph 6-16.)

6-14. HEAT LEAK-TESTING.

a. Prepare service unit for heat leak-test. (Refer to paragraph 6-11.)

b. Allow tank to vent and stabilize for a period of 6 hours.

c. Attach flowmeter to vent and measure flow. The flowrate shall not exceed 800 cubic inches per minute.

d. If no additional tests are to be performed, secure service unit. (Refer to paragraph 6-16.)

6-15. TESTING FILL AND DRAIN RELIEF VALVE.

a. Disconnect transfer hose from service unit. Cap transfer hose.

b. Connect a regulated source of gaseous nitrogen and a test gage to fill and drain fitting.

c. Close fill and drain valve and open vent valve on service unit.

d. Slowly increase gaseous nitrogen supply until relief valve vents. Relief valve shall vent at 80 ±5 psig.

e. Decrease gaseous nitrogen supply to zero.

f. Adjust relief valve as required, then repeat steps d and e.

g. Secure test equipment and connect transfer hose to fill and drain fittings. Torque transfer hose fitting. (Refer to R-3825-5, Volume I for torque values.)

h. If no additional tests are to be performed, secure service unit. (Refer to paragraph 6-16.)

6-16. SECURING LIQUID NITROGEN SERVICE UNIT.

6-17. The service unit may be secured with liquid nitrogen in the storage tank. Secure the service unit as follows:

a. Open vent valve; ensure fill and drain valve is closed.

b. Close buildup coil valve.

c. Open port C on 3-way gage protector valve. (See figure 6-2.)

d. Ensure transfer hose is free of liquid nitrogen; then store transfer hose on rack on storage tank.

6-18. LUBRICATING LIQUID NITROGEN SERVICE UNIT.

6-19. Lubricate (Method X, R-3825-5, Volume I) the service unit wheel bearings and steering assembly with gear grease No. 627 (Bray Oil Co) or gear grease (MIL-G-23827). Eight lubrication fittings are provided on the steering assembly. Wipe excess lubricant from grease fittings. Ensure lubricant does not contact liquid nitrogen handling component surfaces.

WARNING

Contaminated liquid nitrogen used in a liquid oxygen system can cause an explosion resulting in serious injury or death and damage to equipment.

6-20. PAINTING LIQUID NITROGEN SERVICE UNIT.

WARNING

The following specifies primer (MIL-P-8585), which is flammable and must not be used near heat, sparks, or open flame. It is toxic. Inhalation of its vapors or prolonged contact with the primer can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

6-21. Paint exposed or scratched surfaces of service unit with orange-yellow enamel (Federal Specification TT-E-489), color 13538 (Federal Standard 595). Use a fine wire brush to remove corrosion. Wipe surface clean. Apply zinc chromate primer (MIL-P-8585) as required and allow to dry thoroughly before applying enamel finish coat. Stencil letters with gloss black lacquer (Federal Specification TT-L-32), color 17038 (Federal Standard 595).

6-22. CHECKING PRESSURE GAGE CALIBRATION.

6-23. Pressure gage calibration check consists of checking the pressure gage to a calibrated reference gage. To check the pressure gage, proceed as follows:

a. Remove pressure gage from service unit.

b. See figure 6-6 for pressure gage calibration check requirements. The gage listed in figure 6-6 is used in a liquid nitrogen system.

c and d. (Deleted)

e. Lubricate gage fitting and install pressure gage. (Refer to Lubrication paragraph in R-3825-5, Volume I.)

| Part Number | Nomenclature | Range Accuracy (± Full Scale) | Test Standard[a] Minimum Accuracy (± Full Scale) |
|---|---|---|---|
| 2600538 | Pressure Gage | 0-100 psig (0.5%) | 0.2% |

(a) Range of test standard must be at least 100% but not more than 125% of range of instrument being tested.

Figure 6-6. Pressure Gage Calibration - Check Requirements

6-24. PREPARING LIQUID NITROGEN SERVICE UNIT FOR STORAGE OR SHIPMENT.

6-25. To prepare the service unit for long term storage, in excess of 30 days, perform steps a through m. To prepare service unit for shipment, perform steps a through j.

a. Drain or allow all liquid nitrogen to vaporize from the storage tank. (Refer to SERVICE on service unit access door to drain storage tank.)

b. Close all valves on service unit.

c. Connect transfer hose to a regulated gaseous nitrogen (MIL-P-27401) source using a 10 micron filter.

d. Open fill and drain valve on service unit.

e. Slowly open nitrogen source valve and pressurize storage tank 1 to 5 psig.

f. Close fill and drain valve on service unit.

g. Secure service unit and pressurizing equipment.

h. Cap all open lines and vents in service unit.

i. Thaw and remove all ice deposits from valve compartment components.

CAUTION

Do not use sharp instrument to remove ice deposits as damage to equipment can result.

j. Dry the valve compartment and components completely.

k. Lubricate service unit trailer. (Refer to paragraph 6-18.)

l. Place service unit trailer on blocks to remove weight from tires.

m. Ensure brake is released.

# SECTION VII

## ELECTRICAL INTERFACE SUPPORT 9024460

WARNING

ELECTRICAL INTERFACE SUPPORT 9024460 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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### 7-1. DESCRIPTION AND LEADING PARTICULARS OF ELECTRICAL INTERFACE SUPPORT.

7-2. The electrical interface support supports the customer connect end of the interface cables during handling and installation of the engine and provides readily accessible connections for the interface cables during engine checkout. It consists of a panel mounted by a tubular framework. The interface support weighs approximately 25 pounds and is 26 inches wide, 26 inches deep, and 28 inches high.

### 7-3. CONFIGURATION CHANGES--MANUAL EFFECTIVITY.

7-4. The modification incorporated changing the configuration of the interface support is listed in figure 7-1.

| Approved ECP No. | Part Dash No. | Incorporated in Manual Dated |
|---|---|---|
| J2-346 | -11 | 21 May 1965 |

Figure 7-1. Configuration Change--Manual Effectivity

## 7-5. MAINTENANCE OF ELECTRICAL INTERFACE SUPPORT.

7-6. Maintenance tasks required on the electrical interface support are listed in figure 7-3. Information presented outlines the tasks to be performed, when the task must be performed, and where the data support for the tasks is found. When replacing parts, see figure 7-2 for part identification.

## 7-7. CLEANING ELECTRICAL INTERFACE SUPPORT.

7-8. Clean interface support by handwiping exterior surfaces. (Refer to R-3825-5, Volume I.)

## 7-9. REPAIRING ELECTRICAL INTERFACE SUPPORT.

7-10. Repairing is limited to replacing damaged parts, repairing painted surfaces, and repairing damaged welds.

**WARNING**

**The following specifies primer (MIL-P-8585), which is flammable and must not be used near heat, sparks, or open flame. It is tox'c. Inhalation of its vapors or prolonged contact with the primer can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.**

7-11. Paint interface support using the following:

a. Base coat: yellow zinc chromate primer (MIL-P-8585).

b. Finish coat: red enamel (Federal Specification TT-E-489); color 11136 (Federal Standard 595).

c. Stenciled markings: white cellulose lacquer (Federal Specification TT-L-32); color 37875 (Federal Standard 595).

7-12. Repair cracked welds by grinding out the crack and re-welding to the original weld contour, using welding rod Type 4043 (MIL-E-16053).

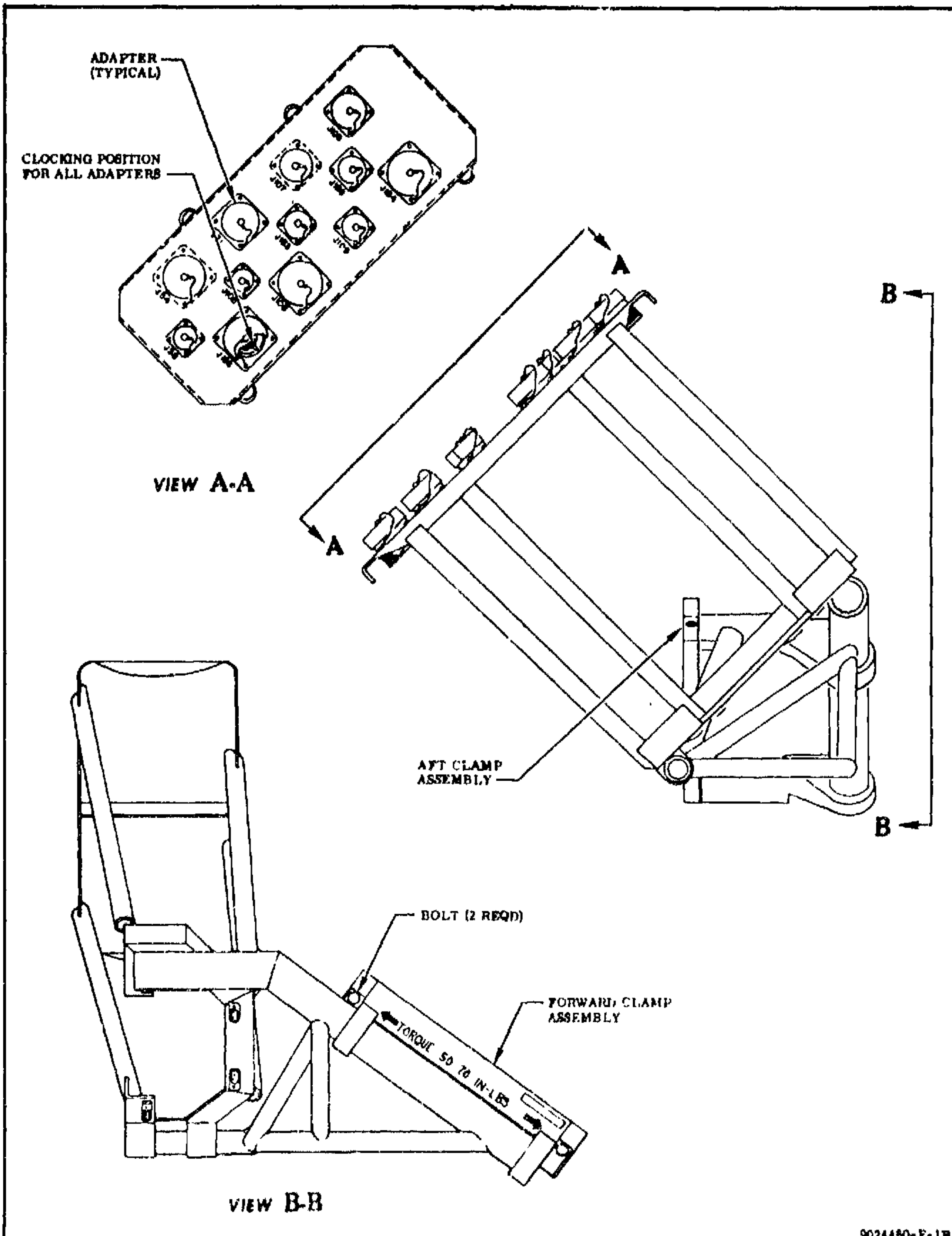


Figure 7-2. Electrical Interface Support

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect electrical interface support for completeness. | X | X | | | Replace missing parts. See figure 7-2. |
| Inspect adapters for damage. | X | X | | | Replace damaged adapters. See figure 7-2. |
| Inspect painted surfaces for damage or wear. | | X | | | Repair painted surfaces. Refer to paragraph 7-11. |
| Inspect welds for cracks. | X | X | | | Repair cracked welds. Refer to paragraph 7-12. |

Figure 7-3. Electrical Interface Support Maintenance Requirements

All data on pages 7-5 and 7-6 deleted.

# SECTION VIII

## SPARK MONITOR/OVERSPEED CUTOFF PANEL G1045

WARNING

SPARK MONITOR/OVERSPEED CUTOFF PANEL G1045 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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Underlined titles denote primary paragraphs.

### 8-1. DESCRIPTION AND LEADING PARTICULARS OF SPARK MONITOR AND OVERSPEED CUTOFF PANEL.

8-3. The spark monitor and overspeed cutoff panel (figure 8-1) is used during an engine firing test. It consists of a spark exciter monitor and a turbine overspeed trip. The spark exciter monitor monitors and transmits the engine spark system signals and spark OK signals to the stage control system for recording purposes. The turbine overspeed trip detects the engine turbine speed signals, monitors engine turbine speed, and initiates an engine cutoff signal in the event of engine turbine overspeed.

8-3. The spark monitor and overspeed cutoff panel is designed for mounting in a standard 19-inch rack. The panel, consisting of a chassis and a front panel, provides for mounting the two electronic units and their associated components. Mounted on the chassis are a spark exciter monitor, a turbine overspeed trip, four relays, five receptacles, a diode terminal board, four diodes, a ground terminal stud, and associated wiring. See figure 8-2 for leading particulars. Instructions for use of the spark monitor and overspeed cutoff panel are in R-3825-1B.

### 8-4. DESCRIPTION AND OPERATION OF SPARK EXCITER MONITOR.

8-5. The spark exciter monitor consists of a base, a cover, four circuit boards, a cable harness, and a ground cable. Each circuit board contains a dc voltage-level discriminator, a pulse-rate discriminator, a pulse shaper, and an AND gate. The cable

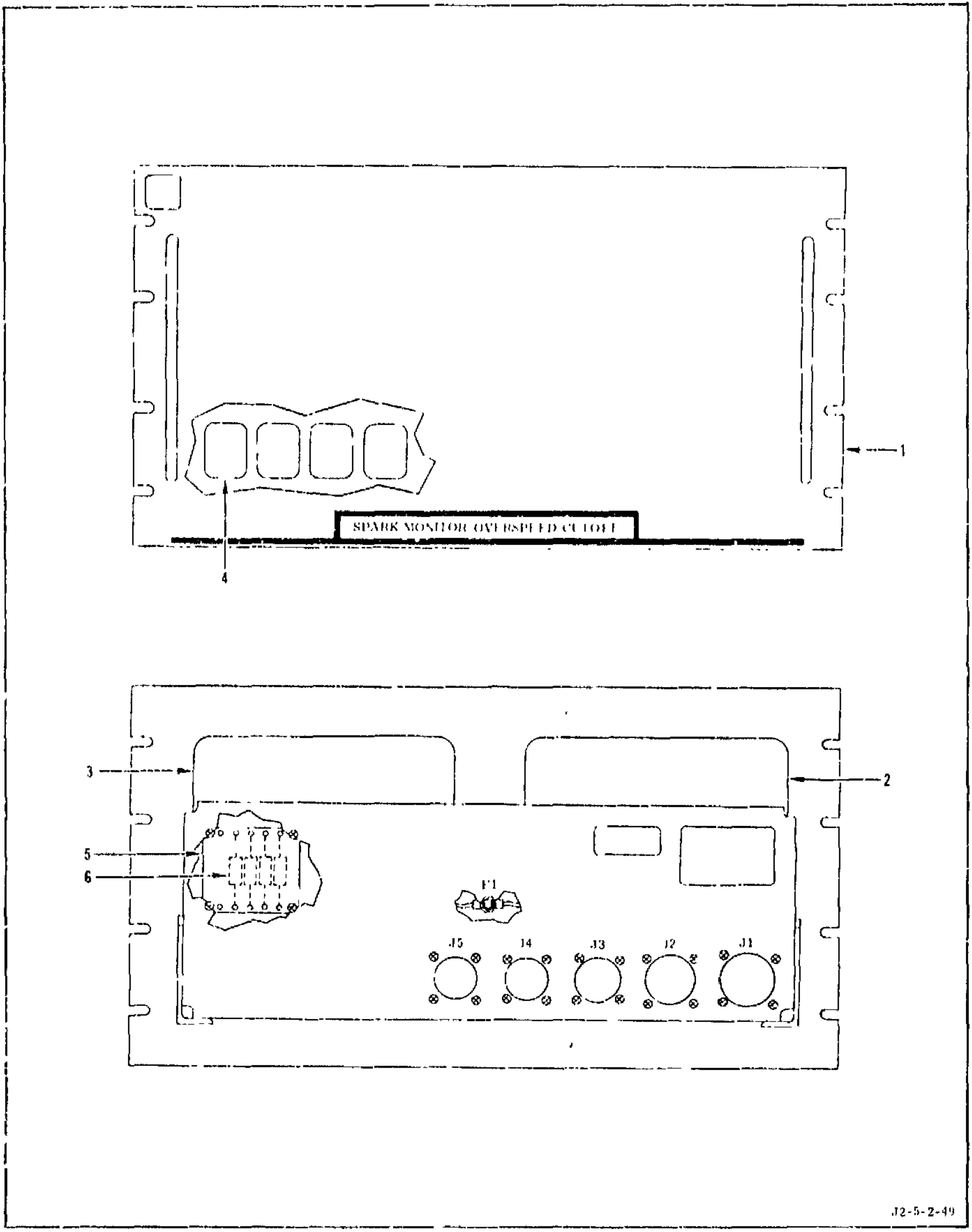



Figure 8-1. Spark Monitor and Overspeed Cutoff Panel (Sheet 1 of 2)

| Index No. | Part No. | Nomenclature |
|---|---|---|
| 1 | G1045 | Spark Monitor and Overspeed Cutoff Panel |
| 2 | 9025789 | Turbine overspeed trip |
| | AN520-10R10 | Screw |
| | LD153-0014-0011 | Washer |
| | SP178 | Filter |
| | AN515-6R6 | Screw |
| | LD153-0011-0008 | Washer |
| | NAS679C06W | Nut |
| 3 | 9016285-21 | Spark exciter monitor |
| | AN520-10R10 | Screw |
| | LD153-0014-0010 | Washer |
| None | 9016288-21 | Circuit board |
| | 9016291 | Plate |
| | NAS110C08-8 | Screw |
| | LD153-0011-0010 | Washer |
| 4 | MS25273-D1 | Relay |
| | AN340-6 | Nut |
| | AN935-6 | Lockwasher |
| | AN960-6 | Washer |
| 5 | 1403-41 | Terminal board |
| | AN515-4R10 | Screw |
| | NAS679A04W | Nut |
| | LD153-0011-0006 | Washer |
| | NAS43DD-0-16 | Spacer |
| 6 | 1N2482 | Diode |

Figure 8-1. Spark Monitor and Overspeed Cutoff Panel (Sheet 2 of 2)

harness contains five receptacles. Four of the five receptacles receive the circuit boards, and the fifth receptacle is mounted on the base. The receptacles receiving the circuit boards contain a keyway that must aline with the key slot on the circuit board for proper installation. Each of the four receptacles are secured to the circuit board enclosure with two nuts and screws. The circuit boards are installed in an enclosure mounted on the base and are secured by the enclosure plate with four screws. The spark exciter monitor monitors the engine spark system signal and transmits these signals to an oscillograph recording console and data recording console during an engine firing test.

8-6. During operation, the spark exciter monitor receives an input signal of 8 ±2 vdc from the engine spark system upon which is superimposed a pedestal pulse signal of 1-4 volts peak discharging at a minimum rate of [illegible]0 pulses per second. The spark exciter monitor circuit conditions the input signal for oscillograph

| | |
|---|---|
| Height | 10.43 inches |
| Width | 19.00 inches |
| Depth | 16.76 inches |
| Spark exciter monitor | |
| Power requirement | 22-32 vdc at 5 amperes |
| Oscillograph output signal | 8 ±2 vdc (positive pulse) |
| Monitor output signal | 28 ±2 vdc at 2 amperes resistive load and 1.5 amperes inductive load |
| Turbine overspeed trip | |
| Supply source | |
| Input signal range | 250 millivolts to 35 volts peak, with cutoff occurring before 750 millivolts |
| Cutoff output signal | 28 ±2 vdc |
| Power requirement | 28 ±2 vdc at 2 amperes resistive load and 1.5 amperes inductive load |
| Frequency range | |
| Fuel pump detector range | 4,000 ±25 to 6,500 ±25 cps |
| Oxidizer pump detector range | 1,200 ±25 to 2,200 ±25 cps |
| Monitor outputs (fuel and oxidizer | |
| Amplitude | 6 ±2 volts, positive going (maximum of 20 volts from ground) |
| Pulse duration | 50 microseconds minimum |

Figure 8-2. Leading Particulars for Spark Monitor and Overspeed Cutoff Panel

recording and will accept, as a GO signal, a dc level of 6 volts (minimum) and a pulse rate of 40 discharges per second (minimum). When these parameters are met on the spark exciter monitor, a signal is supplied to initiate the exciter OK output signal to a recording instrument.

8-7. DESCRIPTION AND OPERATION OF TURBINE OVERSPEED TRIP.

8-8. The turbine overspeed trip consists of a base, a cover, two frequency detectors, two speed-sensing networks, a diode terminal board, a 28-vdc power filter, and associated wiring. The turbine overspeed trip is an electronic device capable of monitoring two ac input signals between 750 millivolts and 35 volts peak. Each input circuit contains two adjustments: a 10,000 ohms potentiometer and a 100,000 ohms potentiometer. The fuel pump frequency detector circuit is adjustable within a range of 4,000 ±25 to 6,500 ±25 cps and is adjusted to a nominal range of 5,680 ±50 cps. The oxidizer pump frequency detector circuit is adjustable within a range of 1,200 ±25 to 2,200 ±25 cps and is adjusted to a nominal range of 1,900 ±20 cps. The turbine overspeed trip initiates an engine cutoff signal 7.5 ±2.5 milliseconds from the time the cutoff frequency is obtained. This time delay does not include the external facility cutoff circuits. The output signal of the overspeed cutoff system, when cutoff is initiated, is 28 vdc and is capable of carrying a maximum of 2 amperes resistive load and 1.5 amperes inductive load. The turbine overspeed trip was designed to monitor and condition the input signal and initiate an engine cutoff signal and, in addition, to provide the capabilities of monitoring and transmitting unconditioned signals from the engine turbine speed-sensing transducers to a recording instrument.

8-9. A 28-vdc power source energizes the turbine overspeed trip fuel pump detector and speed-sensing circuit, and the oxidizer pump detector and speed-sensing circuit. (See figure 8-12.) During engine operation, the speed-sensing transducers on the fuel turbine and oxidizer turbine generate an ac voltage that is transmitted to the turbine overspeed trip. When the engine speed-sensing transducers generate an ac signal of 750 millivolts peak, the signal must activate the frequency detector. If, during an engine firing test, an overspeed condition exists in either of the turbopumps, the frequency output will correspond to the pre-set trip frequency of the turbine overspeed trip and provide a 28-vdc signal to initiate engine cutoff.

8-10. CONFIGURATION CHANGES--MANUAL EFFECTIVITY.

8-11. The modifications incorporated in this section that change the configuration of the spark monitor overspeed cutoff panel are listed in figure 8-3.

| Approved ECP No. | MD No. | Incorporated in Manual Dated |
|---|---|---|
| J2-299 | 1 | 21 May 1965 |
| J2-386 | 2 | 15 November 1965 |
| J2-379 | 3 | 15 November 1965 |

Figure 8-3. Configuration Changes--Manual Effectivity

8-12. <u>MAINTENANCE OF SPARK MONITOR AND OVERSPEED CUTOFF PANEL.</u>

8-13. Planned field maintenance required to ensure operation of the spark monitor and overspeed cutoff panel is listed in figure 8-4, which also indicates when the tasks must be performed and refers to data necessary to accomplish these tasks. See figure 8-1 for location and identification of components and figure 8-6 for a list of test equipment required for function-testing the spark monitor and overspeed cutoff panel and calibrating the turbine overspeed trip.

**8-14. INSTALLATION REQUIREMENTS FOR SPARK MONITOR AND OVERSPEED CUTOFF PANEL.**

8-15. The spark monitor and overspeed cutoff panel must be function tested before installation. (Refer to paragraph 8-16.) Requirements for installing the panel are listed in figure 8-5. See figure 8-11 for connector identification.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect for scratched panel | X | | X | | Burnish and paint scratched area. Refer to paragraph 8-20 for paint requirements. |
| Inspect for insecurity of components. | X | | X | | Refer to R-3825-5, Volume I, for torque values. |
| Inspect panel surfaces and electrical components for cleanness. | X | | X | | Refer to R-3825-5, Volume I, for cleaning requirements. |
| Function-test spark monitor and overspeed cutoff panel. | | | | X | Perform before installation, when a malfunction is suspected, after replacing a component, or at 12-month intervals. Refer to paragraph 8-16. |
| Calibrate turbine overspeed trip. | | | | X | Perform when function-test specified results are not obtained, after replacing component, or when new settings are desired. Refer to paragraph 8-22. |
| Test spark exciter monitor circuit board. | | | | X | Perform when function-test specified results are not obtained or before replacing a new circuit board. Refer to paragraph 8-26. |

Figure 8-4. Maintenance Requirements for Spark Monitor and Overspeed Cutoff Panel

| Requirements | Location | Remarks |
|---|---|---|
| 19-inch rack | Base of test stand | Panel is secured to 19-inch mounting rack with 8 screws. |
| System grounding | Panel chassis stud E1 | Torque nut to 19-24 in-lb. |
| Two individual pairs of twisted, shielded wires (MIL-W-16878), 250 feet maximum | Between panel connector J3 and engine connector P54A | Individual twisted pairs must be isolated from ground. Shields must be connected to a single-point ground with minimal resistance with reference to chassis G1045. Loads other than the G1045 must not be connected to these leads.<br>CAUTION<br>Improper installation can cause an erroneous cutoff signal to be generated. |
| Mating connectors MS3106R20-27S and RD414-1009-0001 | Panel connector J3 and engine connector P54A | Required for J3-to-P54A cable. |
| Twisted, shielded wire (MIL-W-16878) | Panel connectors and facility supply monitoring system | Cables required to supply power and transmit signals. |
| Mating connectors | | |
| MS3106R22-19S | Panel connector J1 | |
| MS3106R18-1P | Panel connector J2 | |
| MS3106R18-1S | Panel connector J4 | |
| MS3106R14-6P | Panel connector J5 | |
| Facility wires | From panel connector J1-B to same terminal as engine wire P54-m and from panel connector J1-L to system ground | Required to reduce difference in potential between engine spark exiters and spark monitor panel. |
| Monitor output loads | Between panel connectors J5-A and J5-B, and panel connectors J5-C and J5-D | 10K ±500 ohms, 1/8 watt minimum |

Figure 8-5. Installation Requirements for Spark Monitor and Overspeed Cutoff Panel

| Part No. | Nomenclature | Use |
|---|---|---|
| Model 260 (Simpson), or equivalent | Multimeter[(a)] | To perform voltage and continuity check. |
| Model 535 with a 53/54C plug-in unit (Tektronix), or equivalent | Oscilloscope | To measure and observe voltage peaks, pulse rates, and signal traces. |
| None | Power supply, 18-32 vdc, with ripple of 2 percent under load of 5 amperes and regulated within one percent | To provide regulated power during function test and calibration tests. |
| 9024499-21 | Spark monitor turbine overspeed cutoff test set | To check out panel G1045, G1045 MD1, G1045 MD2, and G1045 MD3 circuitry during function test and calibration, and to test circuit boards. |
| 5273 (Harvey-Hubell), or equivalent | Plug-in adapters[(a)(b)] | To isolate equipment from facility ground. |
| Model 400H (Hewlett-Packard), or equivalent | Vacuum tube voltmeter | To measure ac voltage. |
| Model 7150 (Beckman), or equivalent | Counter-recorder | To read frequency. |
| Model 200CD (Hewlett-Packard), or equivalent (0-5 vac at 0.5 to 100 kc) | Signal generator[(b)] | To drive frequency detectors during calibration of overspeed cutoff unit. |
| None | Transient voltage generator[(c)] | To apply transient rejection voltage during calibration of overspeed cutoff unit. |
| None | Switch, single pole, single throw | To perform calibration test on overspeed cutoff unit. |
| NA5-27292T1 | Relay, 28 vdc, 2 amperes | In calibration test setup of overspeed cutoff unit. |
| 2112-D-H1 (Elastic Stop Nut Corp) | Time-delay relay | In calibration test setup of overspeed cutoff unit. (Set timer to 2 ±0.5 seconds.) |

(a) Not required when calibrating turbine overspeed trip.
(b) Not required when testing spark exciter monitor circuit boards.
(c) Not required when function-testing panel or testing circuit boards.

Figure 8-6. Test Equipment for Spark Monitor and Overspeed Cutoff Panel

## 8-16. FUNCTION-TESTING SPARK MONITOR AND OVERSPEED CUTOFF PANEL.

8-17. See figure 8-7 for test procedures. If results other than those specified are obtained, the malfunction must be isolated and corrected before continuing with the test. If the spark exciter monitor circuit board malfunctions, remove circuit board (paragraph 8-24) and test circuit board (paragraph 8-26). Electrical schematics and wiring diagrams (figures 8-12 through 8-14) are aids for isolating malfunctions. On panels with a frequency other than nominal (5,680 ±50 cps for fuel cutoff and 1,900 ±20 cps for oxidizer cutoff), the required cutoff setting must be obtained.

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 1 | | Obtain test equipment (figure 8-6). | | |
| 2 | Panel | Disconnect connector A1P1 from spark exciter monitor. | | |
| 3 | Panel | Check continuity between A1P1-B and J1-B. | Meter | Less than one ohm |
| 4 | Panel | Reconnect connector A1P1. | | |
| 5 | Panel | Check continuity between:<br>(a) J1-H and J1-N<br>(b) J1-J and J2-H (socket)<br>(c) J1-K and J3-E | Meter | Less than one ohm |
| 6 | Panel and test set | Connect test set ground wire to panel chassis stud E1. | | |
| 7 | Panel and test set | Check continuity between spark exciter monitor ground wire A1E1 and test set handle, and turbine overspeed trip ground wire A2E1 and test set handle. | Meter | Less than one ohm |
| 8 | Panel and power supply | Connect test set to 18-32 vdc power supply. | | |
| 9 | Power supply | Energize and adjust power supply to 28 ±2 vdc. | | |
| 10 | Test set | Press LAMP TEST switch momentarily. | Test set | All lights on momentarily |

Figure 8-7. Function-Testing Spark Monitor and Overspeed Cutoff Panel (Sheet 1 of 6)

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 11 | Panel and test set | Connect test set harness to panel. | | |
| 12 | Panel | Disconnect spark exciter monitor A1P1. | | |
| 13 | Panel and test set | Check continuity between SHIELD CONTINUITY SPARK MONITOR black test jack TP12 and shield of wire connected to A1P1-C. | Meter | Less than one ohm |
| 14 | Panel | Connect spark exciter monitor to A1P1. | | |
| 15 | Panel | Disconnect turbine overspeed trip A2P1. | | |
| 16 | Panel and test set | Check continuity between SHIELD CONTINUITY OVERSPEED CUTOFF black test jack and A2P1-J. | Meter | Less than one ohm |
| 17 | Panel | Connect turbine overspeed trip A2P1. | | |
| 18 | Test set | Move 28 VDC POWER switch ON. | Test set | 28 VDC POWER light comes on. |
| 19 | Test set | Connect oscilloscope leads to COM and to NO. 1 ASI test jack. | | |

NOTE: In steps 20 through 26, a delay time of 0-1 second will occur between the time the switches are moved to the ON position and the time the corresponding light comes on, due to the circuit characteristic.

| | | | | |
|---|---|---|---|---|
| 20 | Test set | Move No. 1 ASI SPARK OK switch to ON. | Test set<br><br>Oscilloscope | No. 1 ASI SPARK OK light comes on.<br><br>6-10 volt pulse with 50 ±1 pulses per second when using test set 9024499 or -11; 6-10 volt pulse with 40 ±1 pulses per second when using test set 9024499-21. |

Figure 8-7. Function-Testing Spark Monitor and Overspeed Cutoff Panel (Sheet 2 of 6)

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 21 | Test set | Remove oscilloscope lead from No. 1 ASI test jack and connect it to No. 2 ASI test jack. | Oscillo-scope | Pulse disappears. |
| 22 | Test set | Move No. 2 ASI SPARK OK switch to ON. | Test set | No. 2 ASI SPARK OK light comes on. |
| | | | Oscillo-scope | 6-10 volt pulse with 50 ±1 pulses per second when using test set 9024499 or -11; 6-10 volt pulse with 40 ±1 pulses per second when using test set 9024499-21. |
| 23 | Test set | Remove oscilloscope lead from No. 2 ASI test jack and connect it to No. 1 GG test jack. | Oscillo-scope | Pulse disappears. |
| 24 | Test set | Move No. 1 GG SPARK OK switch to ON. | Test set | No. 1 GG SPARK OK light comes on. |
| | | | Oscillo-scope | 6-10 volt pulse with 50 ±1 pulses per second when using test set 9024499 or -11; 6-10 volt pulse with 40 ±1 pulses per second when using test set 9024499-21. |
| 25 | Test set | Remove oscilloscope lead from No. 1 GG test jack and connect it to No. 2 GG test jack. | Oscillo-scope | Pulse disappears. |
| 26 | Test set | Move No. 2 GG SPARK OK switch to ON. | Test set | No. 2 GG SPARK OK light comes on. |
| | | | Oscillo-scope | 6-10 volt pulse with 50 ±1 pulses per second when using test set 9024499 or -11; 6-10 volt pulse with 40 ±1 pulses per second when using test set 9024499-21. |

Figure 8-7. Function-Testing Spark Monitor and Overspeed Cutoff Panel (Sheet 3 of 6)

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 27 | Test set | Check continuity between CONTACT CLOSURE TEST jacks. | Meter | Less than one ohm |
| 28 | Test set | Move No. 2 GG SPARK OK switch to OFF | Test set | No. 2 GG SPARK OK light goes off. |
| | | | Oscilloscope | Pulse disappears. |
| 29 | Test set | Check for no continuity between CONTACT CLOSURE TEST jacks. | Meter | Greater than 10,000 ohms |
| 30 | Test set | Move the following switches to OFF: | Test set | The following lights go off: |
| | | (a) No. 1 GG SPARK OK | | (a) No. 1 GG SPARK OK |
| | | (b) No. 2 ASI SPARK OK | | (b) No. 2 ASI SPARK OK |
| | | (c) No. 1 ASI SPARK OK | | (c) No. 1 ASI SPARK OK |
| 31 | Test set | Remove oscilloscope leads from COM and No. 2 GG test jack. | | |
| 32 | Test set | Connect test equipment to test set (figure 8-9). | | |
| 33 | Signal generator | Set frequence range to 100X. | | |
| 34 | Signal generator | Rotate frequency adjustment dial to minimum frequency. | | |
| 35 | Signal generator | Remove ground lug from chassis ground terminal. | | |
| 36 | Test equipment | Energize signal generator, counter-recorder, and vacuum tube voltmeter; allow to warm up for 30 minutes. | | |
| 37 | Signal generator | Adjust amplitude control until voltmeter indicates 0.7 to 1.0 volts rms or 1.0 to 1.5 volts peak. | | |

Figure 8-7. Function-Testing Spark Monitor and Overspeed Cutoff Panel (Sheet 4 of 6)

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 38 | Test set | Move OVERSPEED CUTOFF TEST switch to FUEL CUTOFF ON. | | |
| 39 | Signal generator | Adjust frequency output until FUEL CUTOFF light comes on. Record frequency output. | Counter-recorder | 5,680 ±50 cps or required cutoff setting |
| 40 | Test set | Check voltage between DC VOLTAGE OUTPUT CHAN A test jack and COM test jack. | Meter | 28 ±2 vdc |
| 41 | Oscilloscope and counter-recorder | Deenergize, and connect plug-in adapters (figure 8-6) between power supply and oscilloscope and counter-recorder. | | |

WARNING: The oscilloscope and counter-recorder are not grounded. Contact with this equipment can cause serious injury or death.

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 42 | Oscilloscope and counter-recorder | Take necessary precautions to avoid electrical shock; then energize. | | |
| 43 | Oscilloscope and test set | Connect leads between CHAN A of oscilloscope and TURBINE SPEED OUTPUT FUEL FREQUENCY test jacks. Black test jack is negative. | Oscilloscope | Trace equals frequency output in step 39, ±5 cps. Pulse amplitude equals 6 volts minimum. Pulse width equals 50 microseconds minimum. |
| 44 | Oscilloscope and counter-recorder | Take necessary precautions to avoid electrical shock; then deenergize and remove plug-in adapters. Connect to power supply and energize. | | |
| 45 | Signal generator | Decrease frequency output until FUEL CUTOFF light goes off. | Counter-recorder | Below 5,680 ±50 cps or required cutoff setting |
| 46 | Signal generator | Rotate frequency adjustment dial to minimum frequency. | | |

Figure 8-7. Function-Testing Spark Monitor and Overspeed Cutoff Panel (Sheet 5 of 6)

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 47 | Test set | Move OVERSPEED CUTOFF TEST switch to OXIDIZER CUTOFF ON. | | |
| 48 | Signal generator | Adjust frequency output until OXIDIZER CUTOFF light comes on. Record frequency output. | Counter-recorder | 1,900 ±20 cps or required cutoff setting |
| 49 | Test set | Check voltage between DC VOLTAGE OUTPUT CHAN B test jack and COM test jack. | Meter | 28 ±2 vdc |
| 50 | Oscilloscope and counter-recorder | Deenergize, and connect plug-in adapters (figure 8-6) between power supply and oscilloscope and counter-recorder. | | |

WARNING: The oscilloscope and counter recorder are not grounded. Contact with this equipment can cause serious injury or death.

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 51 | Oscilloscope and counter-recorder | Take necessary precautions to avoid electrical shock; then energize. | | |
| 52 | Oscilloscope and test set | Connect leads between CHAN B of oscilloscope and TURBINE SPEED OUTPUT OXIDIZER FREQUENCY test jacks. Black test jack is negative. | Oscilloscope | Trace equals the frequency output in step 48, ±5 cps. Pulse amplitude equals 6 volts minimum. Pulse width equals 50 microseconds minimum. |
| 53 | Oscilloscope and counter-recorder | Take necessary precautions to avoid electrical shock; then deenergize and remove plug-in adapters. Connect to power supply and energize. | | |
| 54 | Signal generator | Decrease frequency output until OXIDIZER CUTOFF light goes off. | Counter-recorder | Below 1,900 ±20 cps or required cutoff setting. |
| 55 | Test set | Move 28 VDC POWER switch to OFF. | Test set | 28 VDC POWER light goes off. |
| 56 | Test equipment | Turn off power supply, move all switches to off position, and secure test set and test equipment. | | |

Figure 8-7. Function-Testing Spark Monitor and Overspeed Cutoff Panel (Sheet 6 of 6)

8-18. STORING SPARK MONITOR AND OVERSPEED CUTOFF PANEL.

8-19. Prepare spark monitor and overspeed cutoff panel for storage as follows:

a. Clean panel and components. (Refer to R-3825-5, Volume I.)

b. Install protective covers on electrical connectors.

c. Wrap panel with grease-proof barrier material (MIL-B-131, Grade A), or equivalent, and seal wrapping to protect panel from moisture and dust.

8-20. MAINTENANCE OF SPARK MONITOR AND OVERSPEED CUTOFF PANEL COMPONENTS.

8-21. Maintenance of the panel components consists of removing, installing, and replacing components listed in figure 8-1. No special instructions are required to remove and install the panel components except for those components listed in the following paragraphs. See figures 8-11 through 8-14 to ensure proper wiring installation, refer to section I for applicable torque values, and perform a function test (paragraph 8-16) after installing a component. The front panel must be painted, when required, with grey enamel (Federal Specification TT-E-529); color 26440 (Federal Standard 595), except for 1/4 inch around each of the four holes on the chassis mounting bracket, which must be free of paint and other insulating materials.

8-22. CALIBRATING TURBINE OVERSPEED TRIP.

8-23. See figure 8-8 for calibrating procedures for the turbine overspeed trip. The turbine overspeed trip need not be removed from the chassis to accomplish calibration. A nominal setting of 5,680 ±50 cps for the fuel pump turbine overspeed trip and 1,900 ±20 cps for the oxidizer pump turbine overspeed trip is used for this calibration. When calibrating panels with a required overspeed trip level, use that setting for calibration. The calibration procedure can be used for either fuel or oxidizer frequency detectors. When calibrating the oxidizer frequency detector, use the information in parentheses in figure 8-8.

| Step | Operation | Result |
|---|---|---|
| 1 | Obtain test equipment (figure 8-6). | |
| 2 | Connect test set connectors P4 and P5 and terminal E1 to panel connectors J4 and J5 and panel chassis stud E1. | |
| 3 | Make sure that dust cap is installed on test set connector P1. | |
| 4 | Move all test set switches to off position. | |
| 5 | Connect oscilloscope, counter-recorder, signal generator, and VTVM to test set as shown in figure 8-9. | |
| 6 | Connect test set to 18-32 vdc power supply. | |
| 7 | Energize and adjust power supply to 28 ±2 vdc. | |

Figure 8-8. Calibrating Turbine Overspeed Trip (Sheet 1 of 5)

| Step | Operation | Result |
|---|---|---|
| 8 | On test set, move OVERSPEED CUTOFF TEST switch to FUEL CUTOFF ON (OXIDIZER CUTOFF ON). | |
| 9 | Remove plate on top of cutoff unit cover to gain access to adjusting potentiometers. | |
| 10 | On test set, move 28 VDC POWER switch to ON. | 28 VDC POWER light comes on. |
| 11 | Rotate FUEL PUMP (LOX PUMP) potentiometer R1 on each speed sensing network clockwise to minimum resistance; then rotate counterclockwise 20 ±5 turns to midpoint settings. | |
| 12 | Energize test equipment. | |
| 13 | Adjust signal generator amplitude control until voltmeter indicates 0.7 to 1.0 volt rms or 1.0 to 1.5 volts peak. Record. | |
| 14 | Adjust signal generator frequency output to 5,680 ±50 cps (1,900 ±20 cps) or to required cutoff frequency. | Counter-recorder indicates frequency setting. |
| 15 | Adjust output voltage to voltage recorded in step 13. | |
| 16 | On turbine overspeed trip, rotate FUEL PUMP (LOX PUMP) potentiometer R2 until FUEL CUTOFF (OXIDIZER CUTOFF) light comes on. If FUEL CUTOFF (OXIDIZER CUTOFF) light does not come on, perform step 17. If light does come on, proceed to step 18. | |
| 17 | Adjust frequency cutoff set point for each turbine overspeed trip circuit by rotating FUEL PUMP (LOX PUMP) coarse potentiometer R2 and fine potentiometer R1 clockwise to increase frequency. Rotate potentiometers counterclockwise to decrease frequency. | FUEL CUTOFF (OXIDIZER CUTOFF) light comes on when trip frequency in step 14 is intersected. |

NOTE: To make adjustment, it may be necessary to decrease the signal generator frequency output to 2 percent below the trip frequency and then adjust the signal generator frequency to the desired trip setting several times. The FUEL CUTOFF (OXIDIZER CUTOFF) light will go off when the trip frequency is decreased and will come on when the trip frequency setting is intersected.

| | | |
|---|---|---|
| 18 | While FUEL CUTOFF (OXIDIZER CUTOFF) light is on, momentarily disconnect test leads from signal generator. | FUEL CUTOFF (OXIDIZER CUTOFF) light goes off, then comes on. |

Figure 8-8. Calibrating Turbine Overspeed Trip (Sheet 2 of 5)

| Step | Operation | Result |
|---|---|---|
| 19 | Adjust power supply to 20.5 ±0.5 vdc. | |
| 20 | Recheck cutoff setting of both circuits. | Cutoff frequency as indicated on signal generator must not vary more than ±50 (±20) cps from settings obtained in step 14. |
| 21 | Deenergize signal generator. | |
| 22 | Adjust power supply to 28 ±2 vdc. | |
| 23 | Connect oscilloscope leads to TURBINE SPEED FUEL FREQUENCY red test jack and OXIDIZER FREQUENCY red test jack. Connect oscilloscope negative lead to FUEL FREQUENCY and OXIDIZER FREQUENCY black test jacks and COM black test jack. | |
| 24 | Connect a test lead between TURBINE SPEED FUEL FREQUENCY black test jack and OXIDIZER FREQUENCY black test jack. Connect a test lead between OXIDIZER FREQUENCY black test jack and COM test jack. | |
| 25 | Energize signal generator. | |
| 26 | On test set, move OVERSPEED CUTOFF TEST switch to FUEL CUTOFF ON (OXIDIZER CUTOFF ON). | Oscilloscope must indicate same frequency as signal generator ±10 cps, a voltage amplitude pulse of 6 volts minimum, and a pulse width of 50 microseconds minimum. |
| 27 | Remove oscilloscope leads from test jacks and connect to DC VOLTAGE OUTPUT CHAN A and CHAN B. | |
| 28 | Deenergize signal generator. | |

NOTE: Steps 29 through 37 apply transient rejection voltage to prevent transient voltage from tripping the turbine overspeed trip.

| Step | Operation | Result |
|---|---|---|
| 29 | Fabricate a transient voltage generator (figures 8-6 and 8-9); then connect generator to positive and negative terminals of power supply. | |

Figure 8-8. Calibrating Turbine Overspeed Trip (Sheet 3 of 5)

| Step | Operation | Result |
|---|---|---|
| 30 | Set oscilloscope channels A and B for horizontal sweep to 10 ms/cm, vertical sweep to 10 volts/cm, and input selector switch to dc input position. | Oscilloscope is ready for use. |
| 31 | Adjust power supply to 28 ±2 vdc. | |
| 32 | Energize signal generator. | |
| 33 | Adjust signal generator frequency output 100 cps below nominal frequency of 5,680 ±50 cps or required frequency. | |
| 34 | Turn on transient voltage generator power switch. Allow generator to cycle for 3 ±1 minutes for this step and steps 35 and 37. | (a) FUEL CUTOFF (OXIDIZER CUTOFF) lights must remain off. (b) Oscilloscope must not indicate any transient voltage. |
| 35 | On test set, move OVERSPEED CUTOFF TEST switch to FUEL CUTOFF ON. | (a) FUEL CUTOFF light remains off. (b) Oscilloscope must not indicate any transient voltage. |
| 36 | Adjust signal generator frequency output 100 cps below nominal frequency of 1,900 ±20 cps or required frequency. | |
| 37 | On test set, move OVERSPEED CUTOFF TEST switch to OXIDIZER CUTOFF ON. | (a) OXIDIZER CUTOFF light remains off. (b) Oscilloscope must not indicate any transient voltage. |
| 38 | Turn off transient voltage generator power switch; then disconnect generator from power supply. | |

NOTE: Steps 39 through 45 ensure that both circuits will initiate a cutoff signal within the frequency settings.

| | | |
|---|---|---|
| 39 | On test set, move OVERSPEED CUTOFF TEST switch to OFF. | |
| 40 | Adjust signal generator frequency output to 1,900 ±20 cps or required frequency. | |

Figure 8-8. Calibrating Turbine Overspeed Trip (Sheet 4 of 5)

| Step | Operation | Result |
|---|---|---|
| 41 | On test set, move OVERSPEED CUTOFF TEST switch to OXIDIZER CUTOFF ON. | OXIDIZER CUTOFF light comes on, and FUEL CUTOFF light remains off. |
| 42 | Move OVERSPEED CUTOFF TEST switch to OFF. | OXIDIZER CUTOFF light goes off. |
| 43 | Adjust signal generator frequency output to 5,680 ±50 cps or required frequency. | |
| 44 | On test set, move OVERSPEED CUTOFF TEST switch to FUEL CUTOFF ON. | OXIDIZER CUTOFF light remains off, and FUEL CUTOFF light comes on. |
| 45 | On test set, move OVERSPEED CUTOFF TEST switch to OFF. | FUEL CUTOFF light goes off. |
| 46 | Turn off power supply, and move all switches to off position. | |
| 47 | Disconnect test set from panel connectors. | |
| 48 | Install plate on top of overspeed cutoff unit cover. | |

Figure 8-8. Calibrating Turbine Overspeed Trip (Sheet 5 of 5)

8-24. REMOVING SPARK EXCITER MONITOR CIRCUIT BOARD.

8-25. Remove circuit board from spark exciter monitor as follows:

a. Remove spark exciter monitor from panel chassis.

b. Remove monitor cover from base.

c. Remove screws that secure circuit board plate to circuit board enclosure.

d. Insert a short length of 20-gage wire, or equivalent, into the 2 holes on circuit board. Pull circuit board from enclosure.

8-26. TESTING SPARK EXCITER MONITOR CIRCUIT BOARD.

8-27. Two procedures can be used to test the spark exciter monitor circuit boards. One procedure, using the Electrical Checkout Console G1037 incorporating MD10 change, is in R-3825-5, Volume I, section IV. The other procedure, using spark monitor turbine overspeed test set 9024499-21, is in figure 8-10. The circuit boards must be removed (paragraph 8-24) from the spark monitor to perform this test.

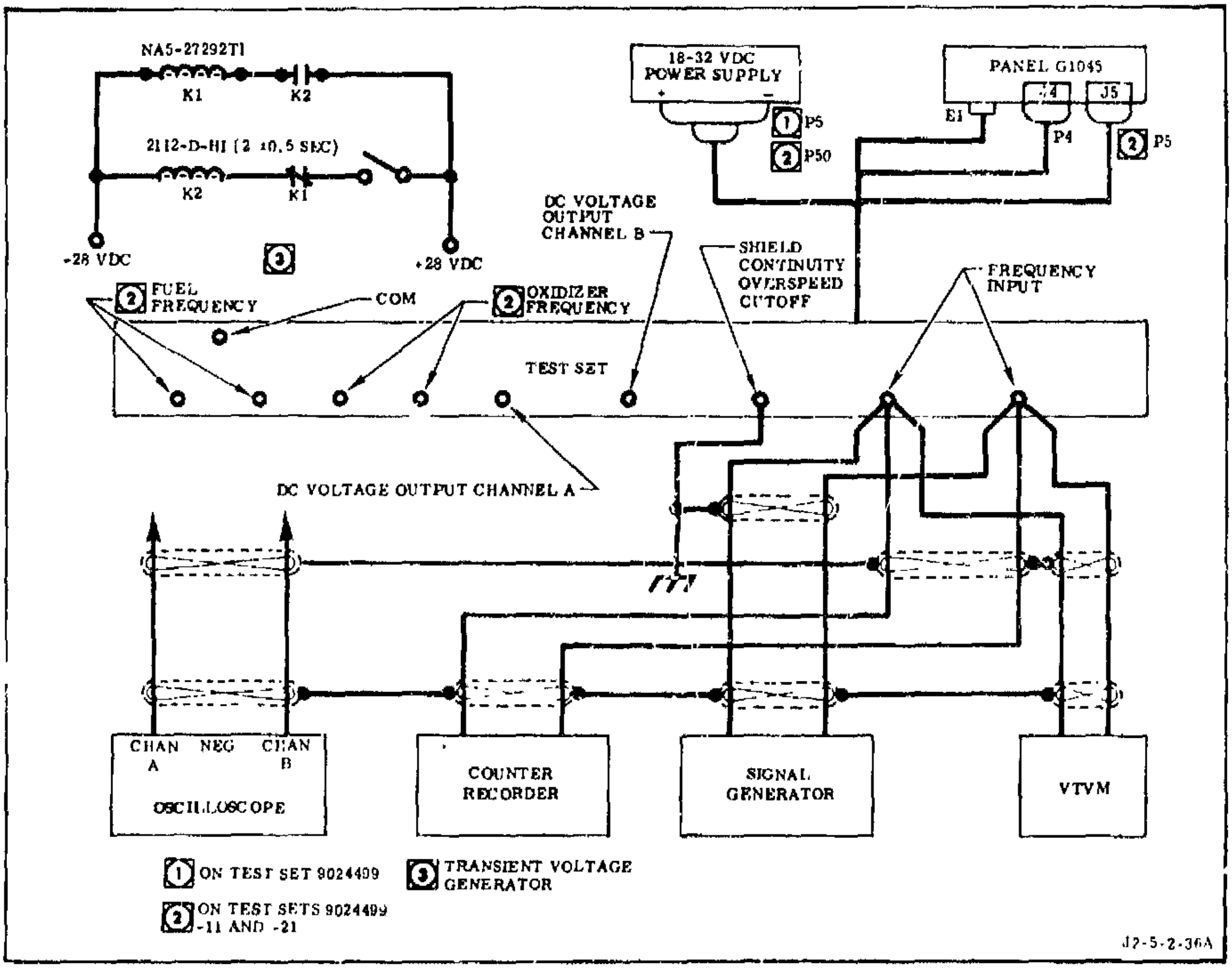



Figure 8-9. Turbine Overspeed Trip Test Setup

| Step | Operation | Result |
|---|---|---|
| NOTE: | Whenever the test requires adjusting a potentiometer, the potentiometer locknut must be loosened, the adjustment made, and the locknut retightened sufficiently to prevent inadvertent movement of the adjustment screw. Required values must be obtained with locknuts tightened. | |
| 1 | Obtain power supply, oscilloscope, test set, counter-recorder, and multimeter. (See figure 8-6.) Connect test equipment as follows:<br><br>a. Connect test set harness connector P50 to 18-32 vdc power supply. | |

Figure 8-10. Testing Spark Exciter Monitor Circuit Board (Sheet 1 of 4)

| Step | Operation | Result |
|---|---|---|
| 1 (cont) | b. Connect oscilloscope, counter-recorder, and multimeter negative test leads to COM test jack of test set, and positive test leads to SIMULATOR OUTPUT test jack of test set.<br><br>c. Connect test set spark exciter monitor test cable to test set and spark exciter monitor circuit board. | |
| 2 | Energize and adjust power supply to 28 ±2 vdc. | |
| 3 | Move 28 VDC POWER switch to on. If required results are not obtained, perform steps 4 through 6 to adjust test set potentiometers; otherwise, proceed directly to step 7. | (a) 28 VDC POWER light comes on.<br><br>(b) Multimeter indicates 6.0 ±0.3 volts, oscilloscope indicates a 1-2 volt pulse, and counter-recorder indicates 33 ±1 pulses. |
| 4 | Adjust DC LEVEL potentiometer until multimeter indicates 6.0 ±0.3 volts. | |
| 5 | Adjust PULSE AMPLITUDE potentiometer until oscilloscope indicates 1-2 volt pulse. | |
| 6 | Adjust PULSE RATE potentiometer until counter-recorder indicates 33 ±1 pulses per second. | |
| 7 | Remove oscilloscope positive test lead from SIMULATOR OUTPUT and connect it to R19 (opposite side of resistor from reference designator R19) on spark exciter monitor circuit board. Remove and connect multimeter positive test lead to +C2 on spark exciter monitor circuit board. | |

NOTE: It may be necessary to remove varnish from component leads to establish positive electrical contact.

| | | |
|---|---|---|
| 8 | Move NO. 1 ASI SPARK OK switch to ON. | |
| 9 | Adjust potentiometer R2 clockwise on spark exciter monitor circuit board until multimeter indicates a minimum of +20 vdc. Readjust potentiometer R2 counterclockwise until multimeter indicates less than +20 vdc. Slowly readjust potentiometer R2 clockwise until multimeter just indicates +20 vdc, and do not adjust potentiometer further or in a counterclockwise direction. | |

Figure 8-10. Testing Spark Exciter Monitor Circuit Board (Sheet 2 of 4)

| Step | Operation | Result |
|---|---|---|
| 10 | Adjust potentiometer R16 clockwise on spark exciter monitor circuit board until pulse appears on oscilloscope; then readjust potentiometer counterclockwise until pulse just disappears. | |
| 11 | Remove test leads from exciter circuit board and connect as follows: | |
| | a. Connect oscilloscope and counter-recorder positive test leads to NO. 1 ASI test jack on test set and negative test leads to COM test jacks on test set. | |
| | b. Connect multimeter positive test lead to SIMULATOR OUTPUT and negative test leads to COM test jack on test set. | |
| | c. Connect oscilloscope TRIGGER INPUT to SIMULATOR OUTPUT on test set. | |
| 12 | Set oscilloscope as follows: | Oscilloscope indicates dc level of 2 vdc or less. |
| | a. SENSITIVITY to 5 volts per centimeter. | |
| | b. SWEEP SPEED to 0.1 second per centimeter. | |
| | c. TRIGGER MODE switch to H.F. SYNC. | |
| | d. TRIGGER SLOPE to EXTERNAL POSITIVE. | |
| 13 | Adjust PULSE RATE potentiometer in increments of one pulse per second. After each increase, actuate RESET switch until NO. 1 ASI SPARK OK light comes on. If required result is not obtained, repeat steps 9 through 13. | Counter-recorder indicates 36-41 pulses per second. |
| 14 | Move 28 VDC POWER switch to OFF. | (a) 28 VDC POWER light goes off.<br>(b) NO. 1 ASI SPARK OK light goes off.<br>(c) Indications disappear from oscilloscope, counter-recorder, and multimeter. |

Figure 8-10. Testing Spark Exciter Monitor Circuit Board (Sheet 3 of 4)

| Step | Operation | Result |
|---|---|---|
| 15 | Move 28 VDC POWER switch to ON. | (a) 28 VDC POWER light comes on.<br>(b) NO. 1 ASI SPARK OK light comes on.<br>(c) Oscilloscope indicates 36-41 pulses per second with amplitude of 5-10 volts per pulse. |

NOTE: Oscilloscope will indicate 24.39 to 27.77 milliseconds per pulse.

| | | |
|---|---|---|
| 16 | Move 28 VDC POWER to OFF | (a) 28 VDC POWER light goes off.<br>(b) NO. 1 ASI SPARK OK light goes off.<br>(c) Indications disappear from oscilloscope, counter-recorder, and multimeter. |
| 17 | Deenergize power supply, and disconnect test set spark exciter monitor test cable from test set and spark exciter monitor circuit board. | |
| 18 | Connect oscilloscope, counter-recorder, and multimeter negative test leads to COM test jack of test set and positive test leads to SIMULATOR OUTPUT test jack of test set. | |
| 19 | Energize and adjust power supply to 28 ±2 vdc. | |
| 20 | Move 28 VDC POWER switch to on. | 28 VDC POWER light comes on. |
| 21 | Adjust DC LEVEL potentiometer until multimeter indicates 6.5 ±0.06 volts. | |
| 22 | Adjust PULSE AMPLITUDE potentiometer until oscilloscope indicates 1-2 volt pulse. | |
| 23 | Adjust PULSE RATE potentiometer until counter-recorder indicates 40 ±1 pulses per second. | |
| 24 | Turn off power supply, move all switches to off position, and secure test equipment. | |

Figure 8-10. Testing Spark Exciter Monitor Circuit Board (Sheet 4 of 4)

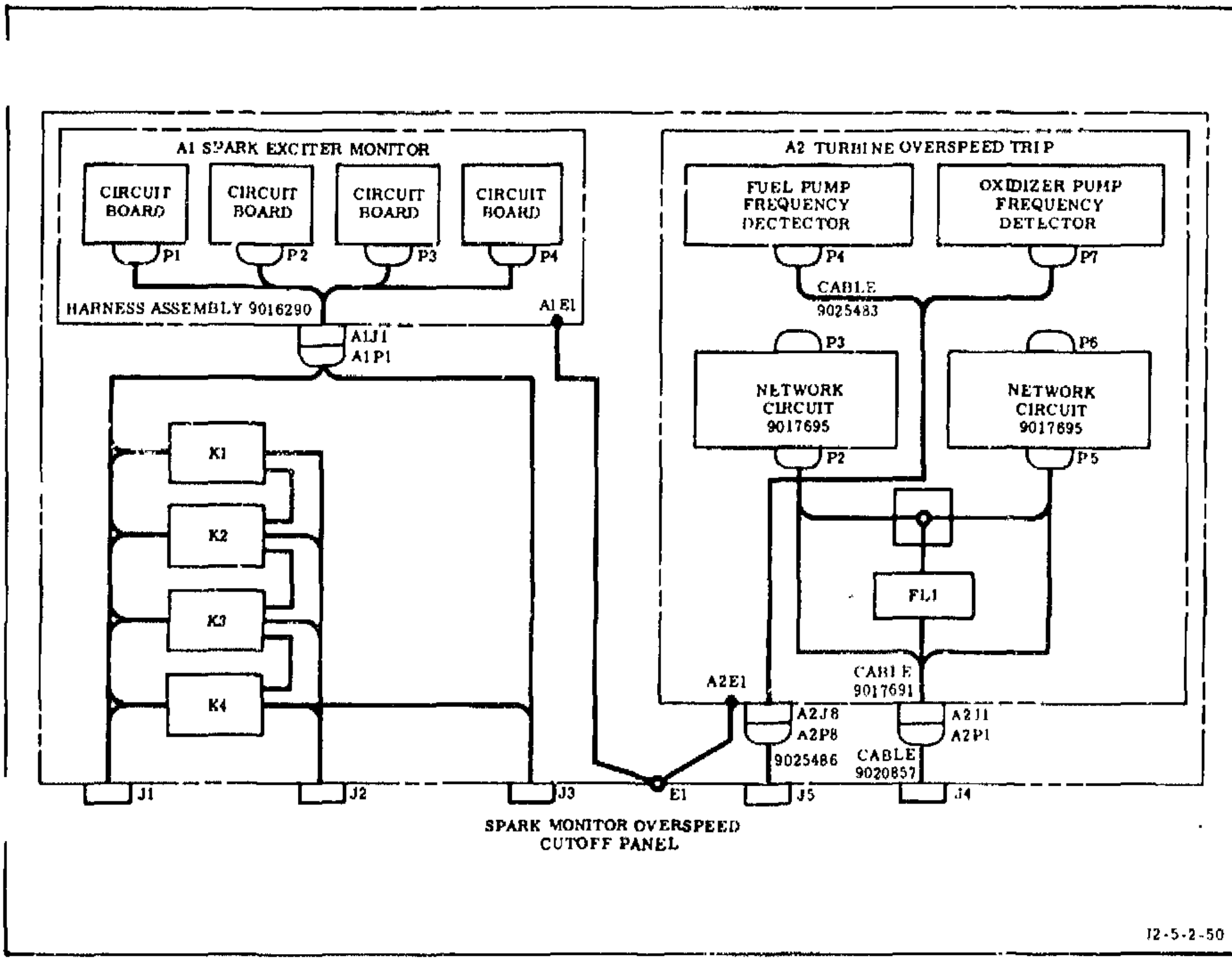



Figure 8-11. Spark Monitor and Overspeed Cutoff Panel Intercable and Wiring Diagram

8-28. INSTALLING SPARK EXCITER MONITOR CIRCUIT BOARD.

8-29. Install circuit board as follows:

a. Aline circuit board key slot with receptacle keyway and press circuit board firmly into enclosure receptacle to ensure a solid connection.

b. Place circuit board plate on enclosure and secure plate with 4 screws. Torque screws to 4-5 in-lb.

c. Connect ground wire between base and cover.

d. Install spark exciter monitor cover onto base and secure cover with 4 screws. Refer to R-3825-5, Volume I, for torque value.

e. Install spark exciter monitor on panel chassis. Refer to R-3825-5, Volume I, for torque value.

f. Function-test the test panel (paragraph 8-16).

8-30. STORING SPARK EXCITER MONITOR CIRCUIT BOARD.

8-31. Prepare circuit board for storing as follows:

a. Clean board surfaces. Refer to R-3825-5, Volume I, for cleaning procedure.

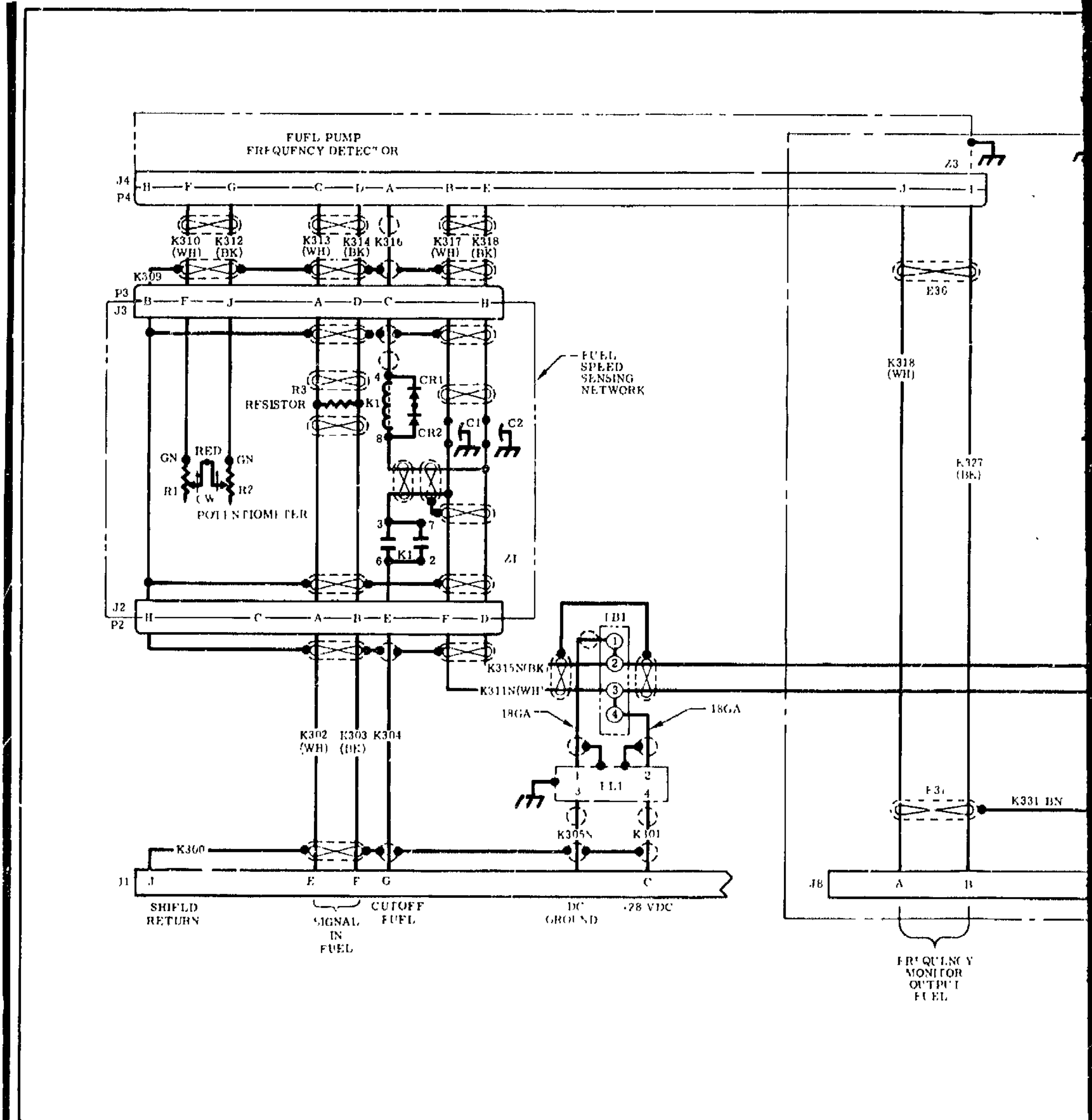
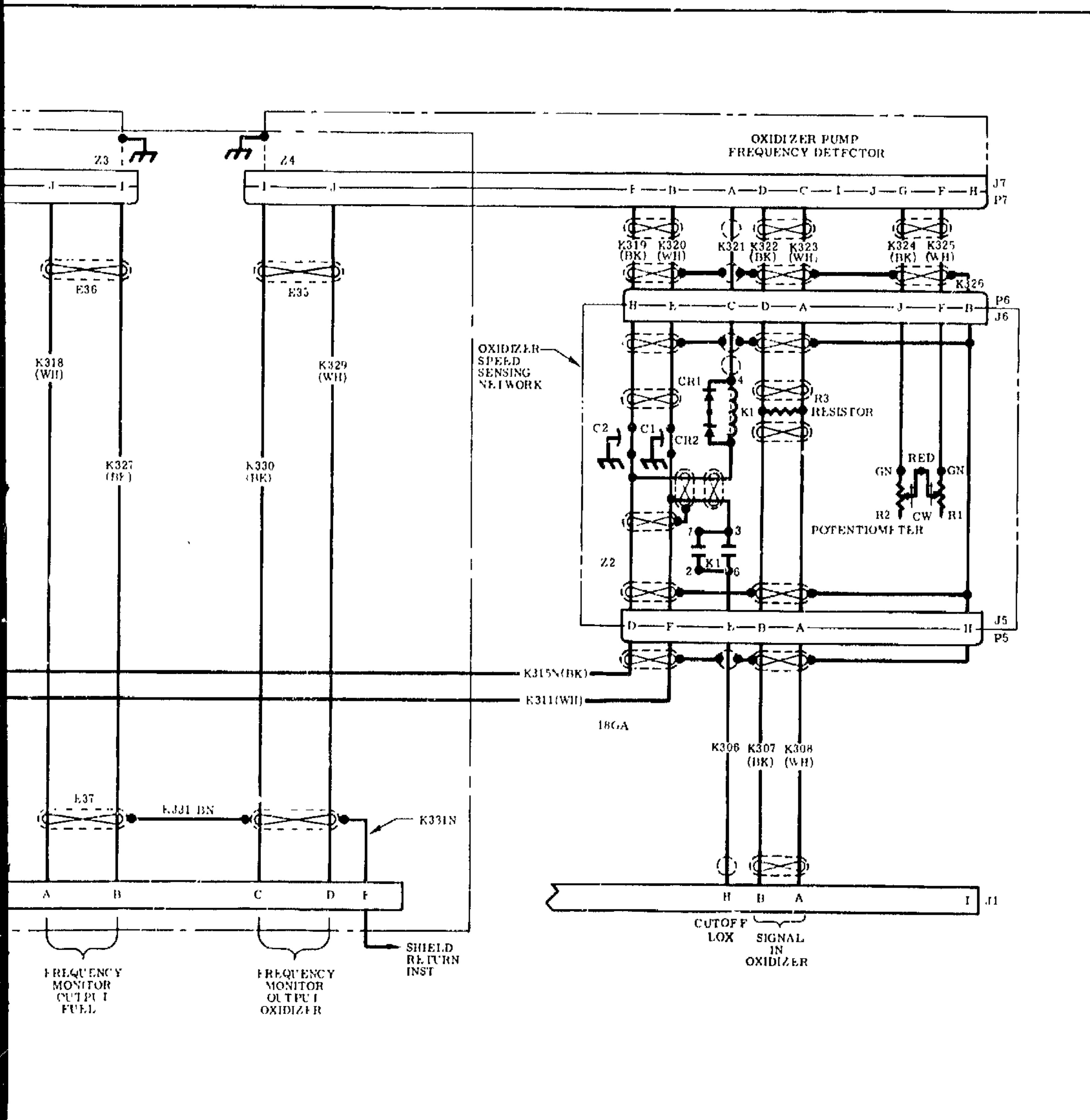
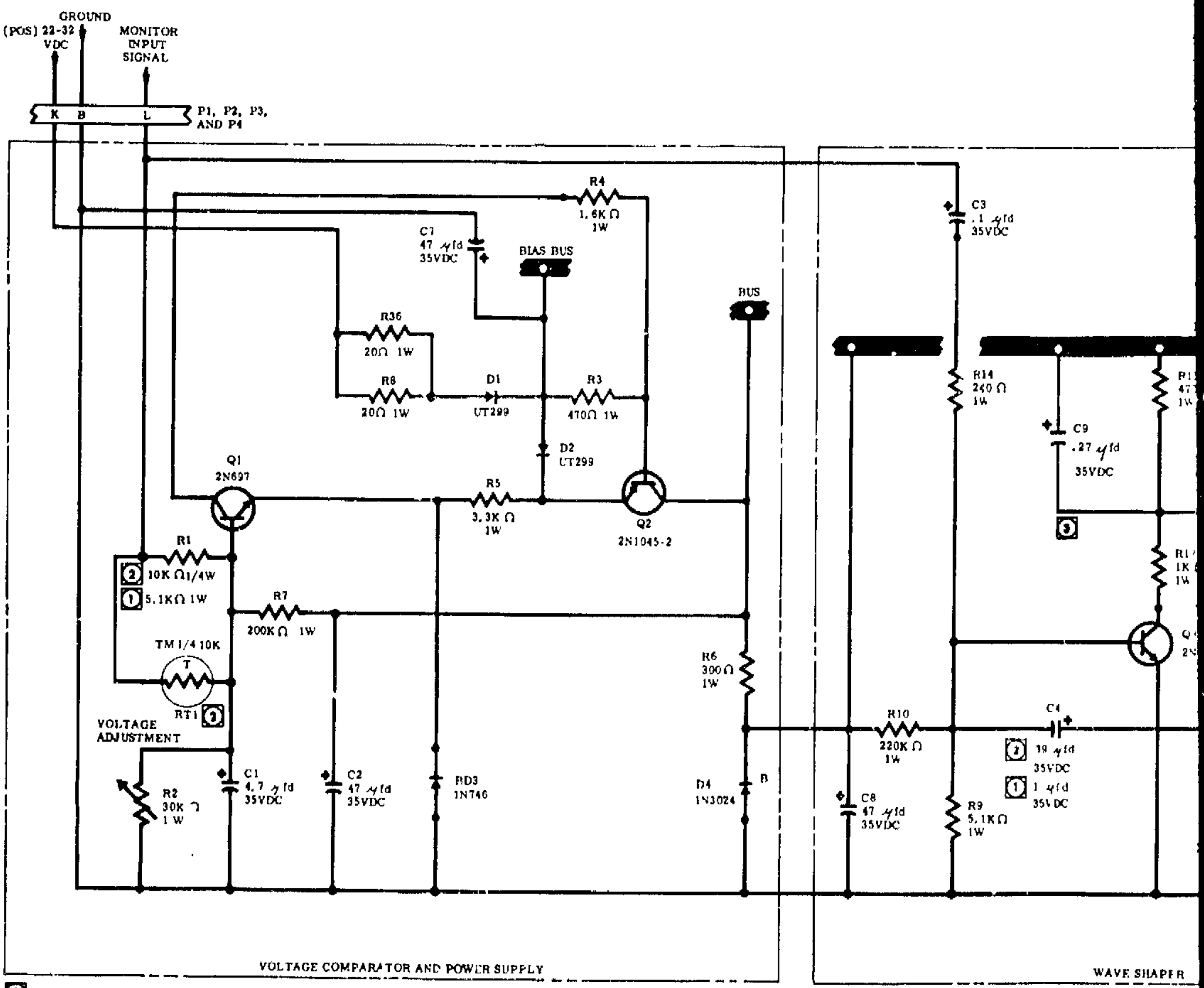



Figure 8-12. Turbine Overspeed Trip Electrical Schematic



OXIDIZER PUMP
FREQUENCY DETECTOR
Z3
Z4
J7
P7
P6
J6
J5
P5
J1
E36
E35
E37
K318
(WH)
K329
(WH)
K327
(BK)
K330
(BK)
K319
(BK)
K320
(WH)
K321
K322
(BK)
K323
(WH)
K324
(BK)
K325
(WH)
K326
OXIDIZER
SPEED
SENSING
NETWORK
CR1
CR2
K1
C1
C2
R3
RESISTOR
GN
RED
R2
CW
R1
POTENTIOMETER
Z2
K315N(BK)
K311(WH)
18GA
K306
K307
(BK)
K308
(WH)
K331 BN
K331N
CUTOFF
LOX
SIGNAL
IN
OXIDIZER
SHIELD
RETURN
INST
FREQUENCY
MONITOR
OUTPUT
FUEL
FREQUENCY
MONITOR
OUTPUT
OXIDIZER


J2-5-2-51




1 ON PANEL G1045 INCORPORATING SPARK EXCITER MONITOR UNIT 9016285

2 ON PANEL G1045 INCORPORATING SPARK EXCITER MONITOR UNIT 9016285-11

3 ON PANEL G1045 INCORPORATING SPARK EXCITER MONITOR UNIT 9016285-21

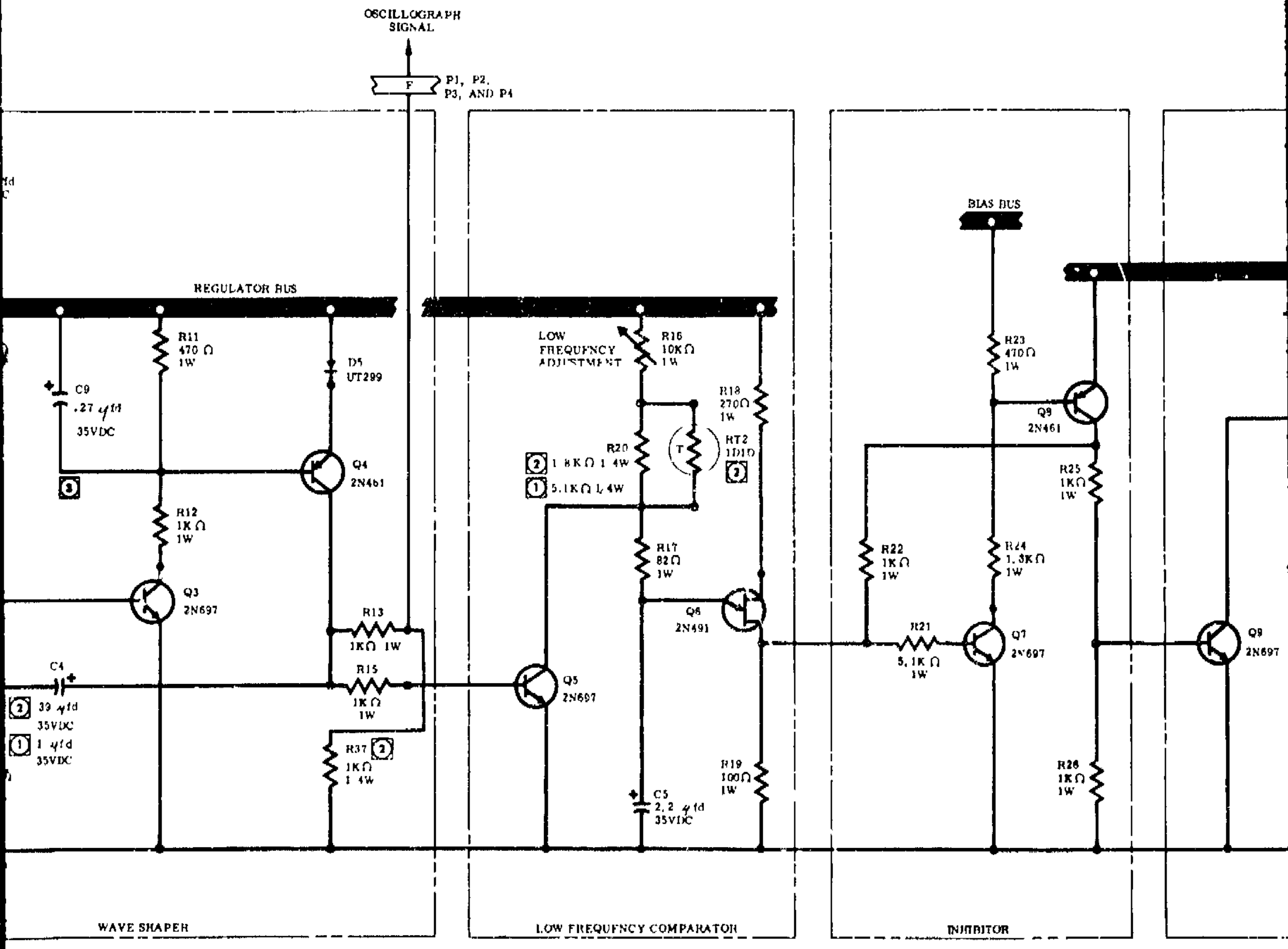



Figure 8-13. Spark Exciter Monitor

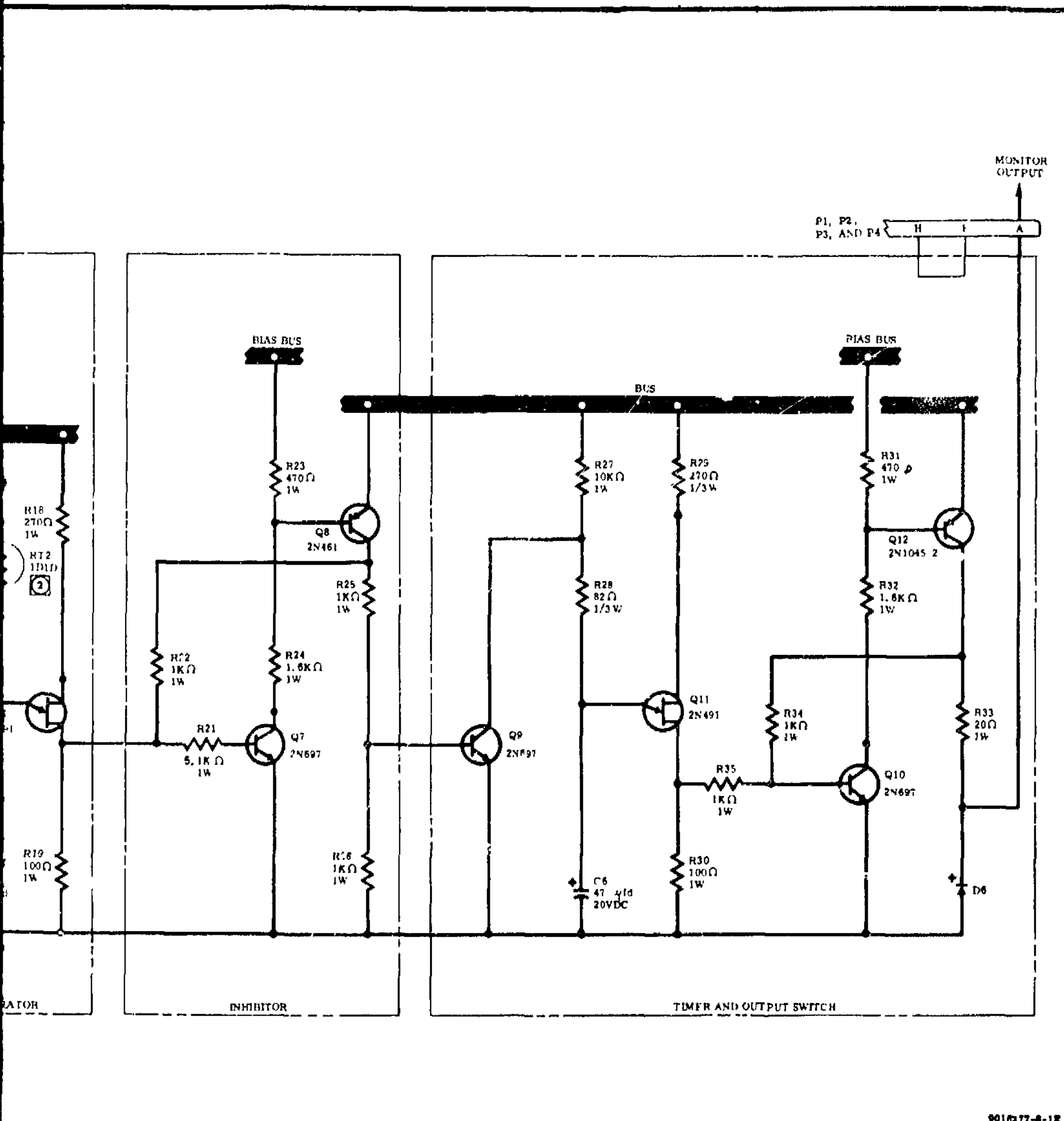



Figure 8-13. Spark Exciter Monitor Electrical Schematic and Wiring Diagram (Sheet 1 of 2)

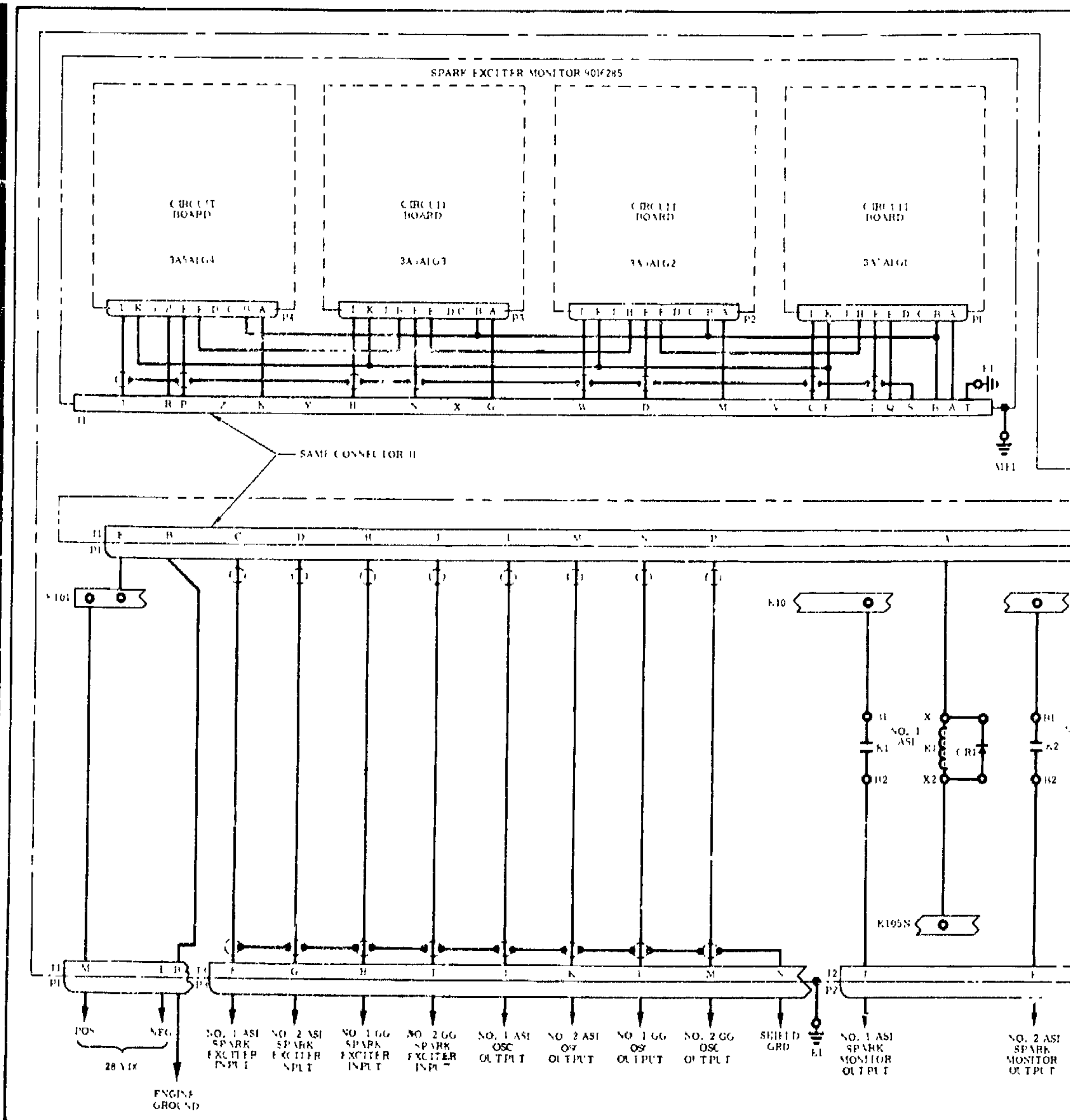
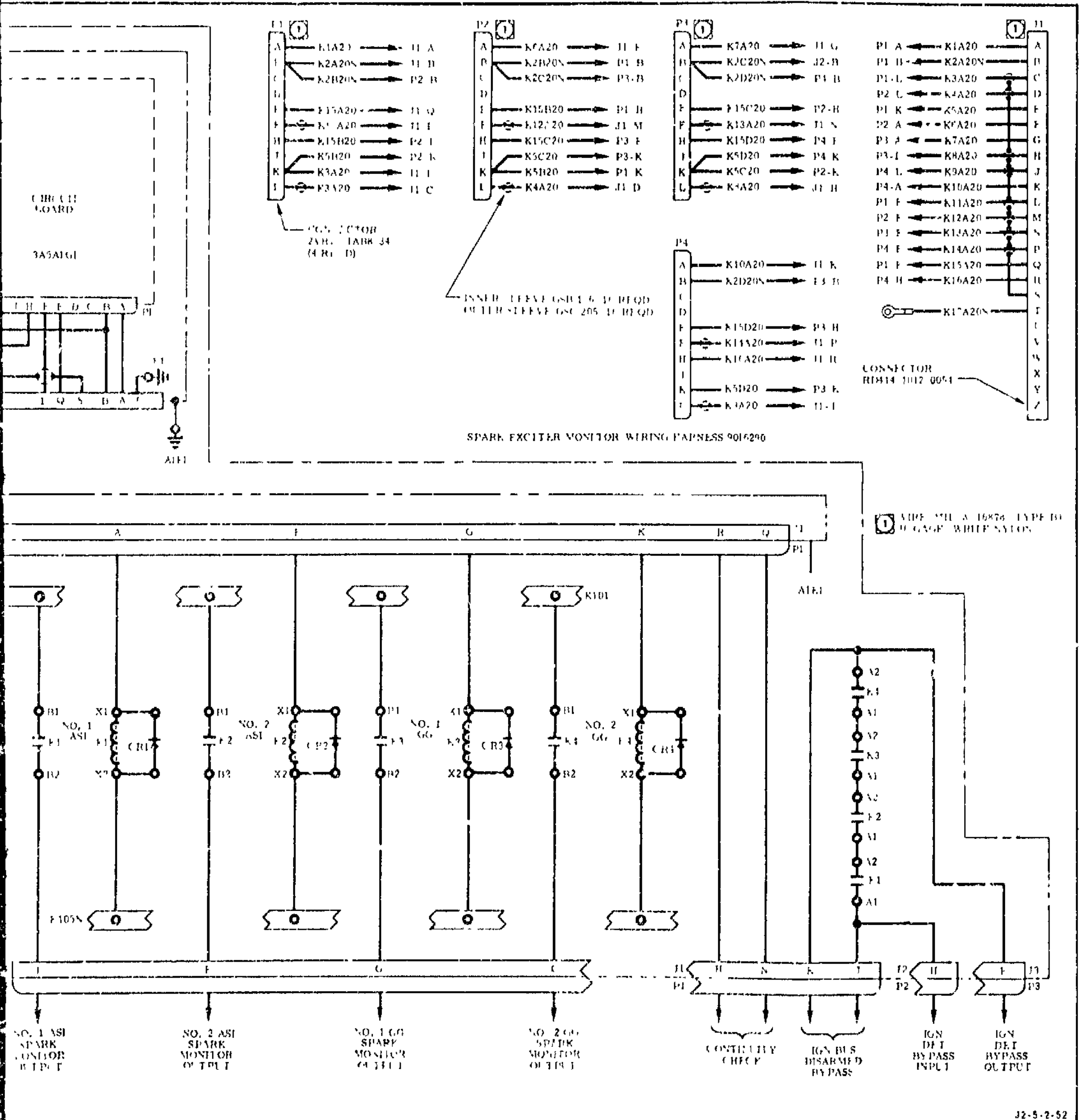
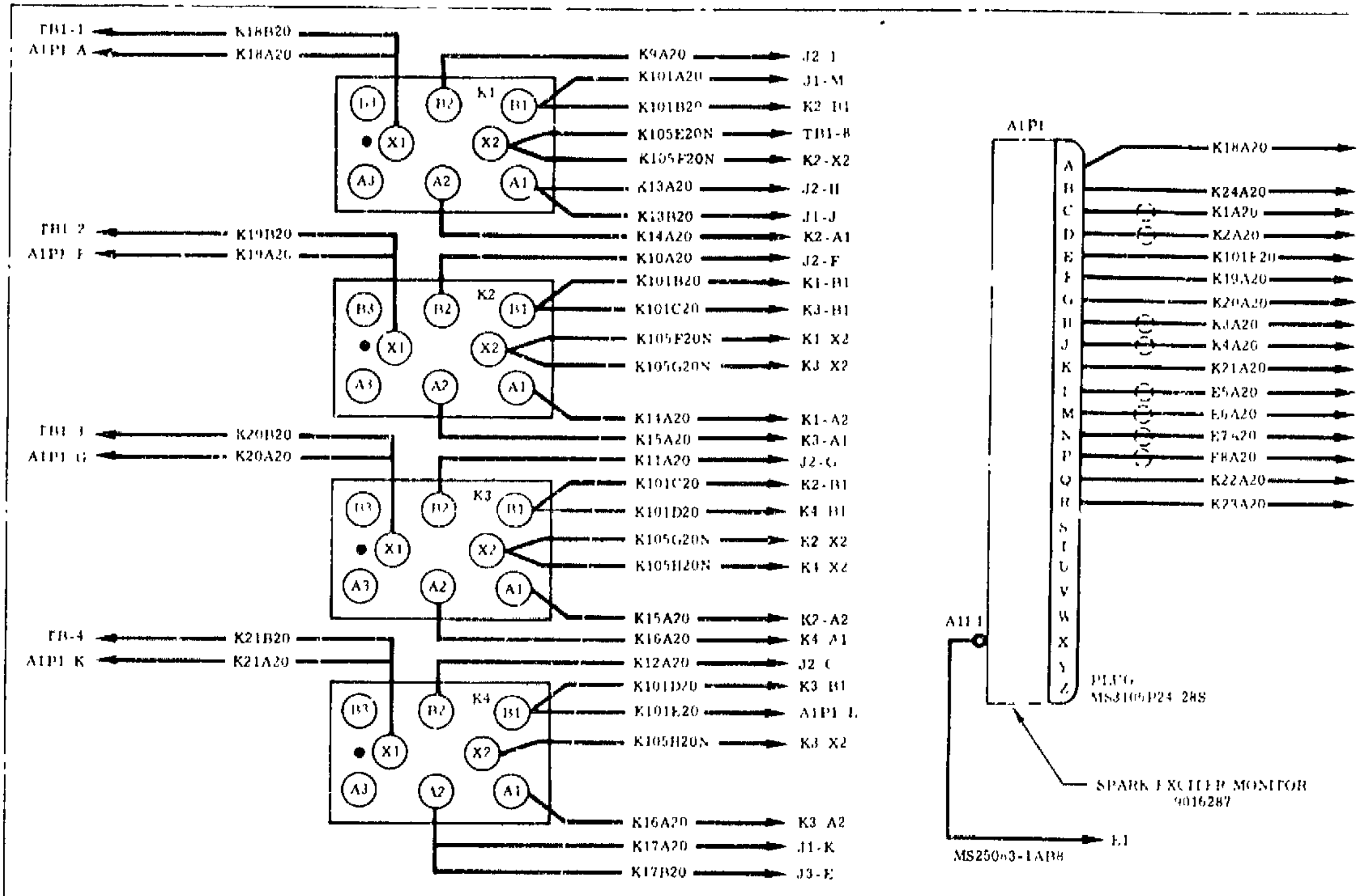


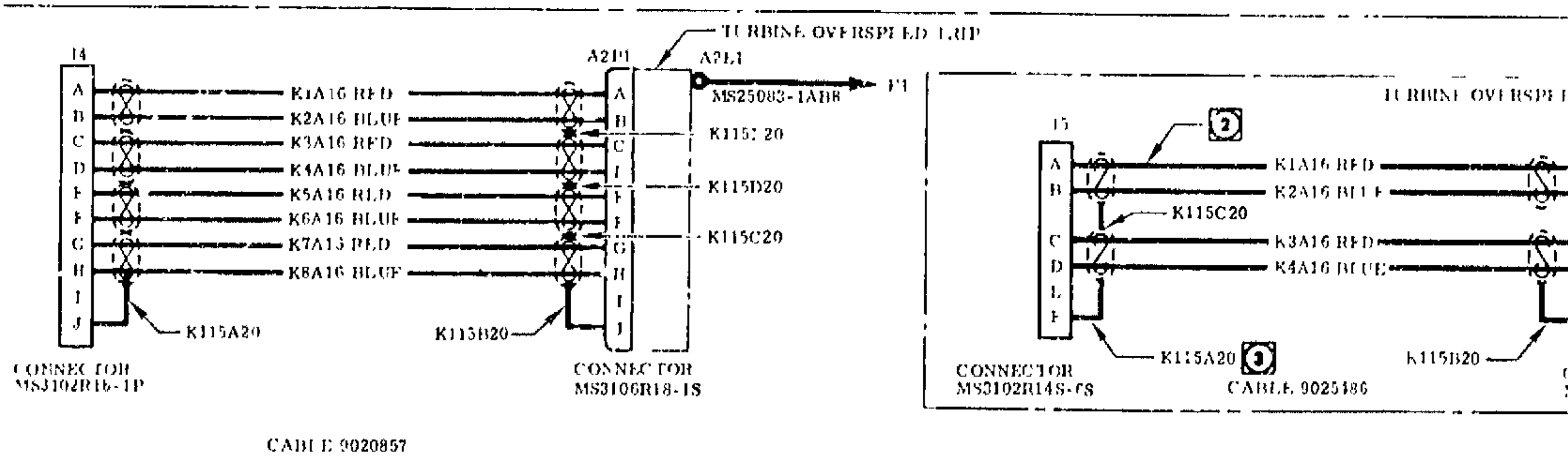

Figure 8-13. Spark Exciter Monitor Electrical Schematic and Wiring Diagram (Sheet 2 of 2)



CIRCUIT BOARD
3A5A1G1
SPARK EXCITER MONITOR WIRING HARNESS 9016290
CONNECTOR RD414 1012 0051
NO. 1 ASI
NO. 2 ASI
NO. 1 GG
NO. 2 GG
NO. 1 ASI SPARK MONITOR OUTPUT
NO. 2 ASI SPARK MONITOR OUTPUT
NO. 1 GG SPARK MONITOR OUTPUT
NO. 2 GG SPARK MONITOR OUTPUT
CONTINUITY CHECK
IGN BUS DISARMED BYPASS
IGN DET BYPASS INPUT
IGN DET BYPASS OUTPUT
J2-5-2-52




SPARK EXCITER MONITOR EXTERNAL WIRING AND CABLE DIAGRAMS




TURBINE OVERSPEED TRIP EXTERNAL CABLE DIAGRAMS

Figu

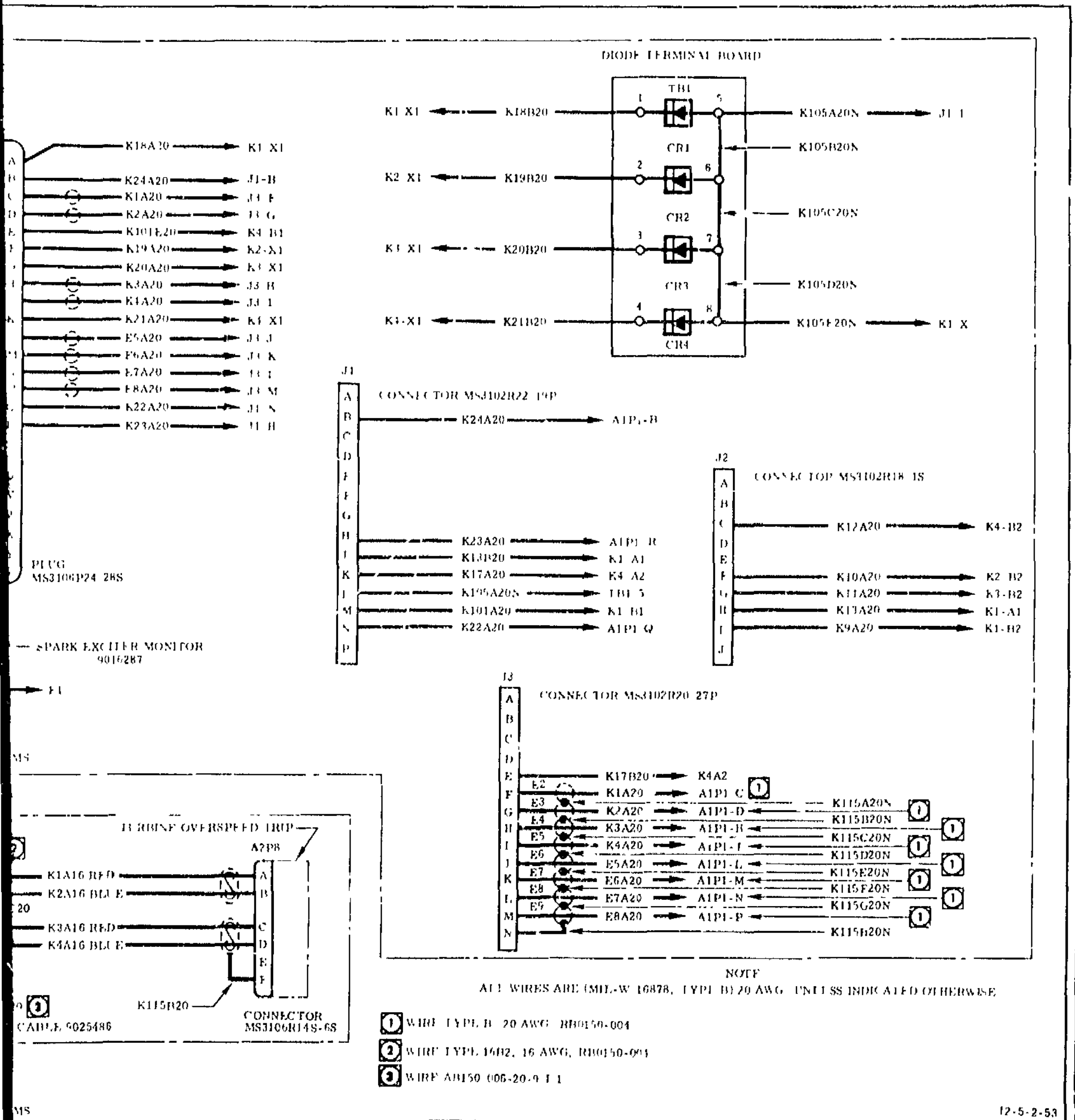



Figure 8-14. Spark Monitor and Overspeed Cutoff Panel Electrical Wiring and Cable Diagram

b. Wrap board with grease-proof barrier material (MIL-B-121, Grade A), or equivalent, and seal wrapping to protect circuit boards from moisture and dust.

8-32. REMOVING TURBINE OVERSPEED TRIP FILTER.

8-33. No special instructions are necessary for removing the turbine overspeed trip filter except that wires from the filter to terminals No. 1 and No. 4 on the terminal board must be unsoldered before removing the filter.

8-34. INSTALLING TURBINE OVERSPEED TRIP FILTER.

8-35. No special instructions are necessary for installing the filter except that wires from the filter to terminal board terminals No. 1 and No. 4 must be soldered, and when connecting lugs to stud terminals, the inner nut on the stud terminal must be held when torquing the outer nut to 6-9 in-lb. The filter stud terminals must be inspected for oil leakage. Leakage is not allowable. The filter must be replaced if leakage exists.

CAUTION

If the inner nut on the stud terminal is allowed to rotate, damage to filter seals will result. Damaged seals will result in oil leakage from the filter.

Pages 8-29 through 8-36 deleted.

# SECTION IX

# COMPONENT SLINGS

**WARNING**

**THE FOLLOWING GROUND SUPPORT EQUIPMENT MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.**

9016779, Component Handler Universal Lifting Sling
9016780, Fuel Turbine Exhaust Duct Lifting Sling
9020265, Start Tank Sling
9022985, Start Tank Sling

TABLE OF CONTENTS



Underlined titles denote primary paragraphs.

## 9-1. DESCRIPTION AND LEADING PARTICULARS OF FUEL TURBINE EXHAUST DUCT LIFTING SLING 9016780.

9-2. The fuel turbine exhaust duct lifting sling (figure 9-1) is used with an overhead hoist to remove or install the exhaust duct or the heat exchanger with the engine in a horizontal position. The sling consists of a 5-inch ring attached to a long strap assembly 48 inches by one inch and a short strap 34 inches by one inch equipped with a buckle and protective pad. Modification to the sling replaces the short strap with a strap 45 inches by one inch to aid in attaching the sling. When lifting the fuel exhaust duct, the short strap of the sling is buckled at center of the duct, aft of the turbopump, with the long strap between the engine and the duct. When lifting the heat exchanger, the short strap is installed on the duct between the bellows and the pump flange, with the long strap extended in front on the power take-off pad between the stud bolts. The sling has a 150-pound working load and a 300-pound proof-test. Information relative to the use of the fuel turbine exhaust duct lifting sling is in Technical Manual R-3825-3.

## 9-3. CONFIGURATION CHANGE--MANUAL EFFECTIVITY.

9-4. The modification incorporated changing configuration of the fuel turbine exhaust duct lifting sling is listed in figure 9-2.

## 9-5. DESCRIPTION AND LEADING PARTICULARS OF START TANK SLING 9020265 AND 9022985.

9-6. The start tank sling (figure 9-3) is used with an overhead hoist to remove or install the start tank. The sling consists of three nylon web straps equipped at the upper ends with hooks and ring buckles attached to a single ring. The lower ends of the straps are equally spaced and attached to a nylon web strap equipped with a hook and ring buckle. The sling is designed for a working load of 125 pounds and is proof-tested to 250 pounds. Information relative to the use of the start tank slings is in Technical Manual R-3825-3.

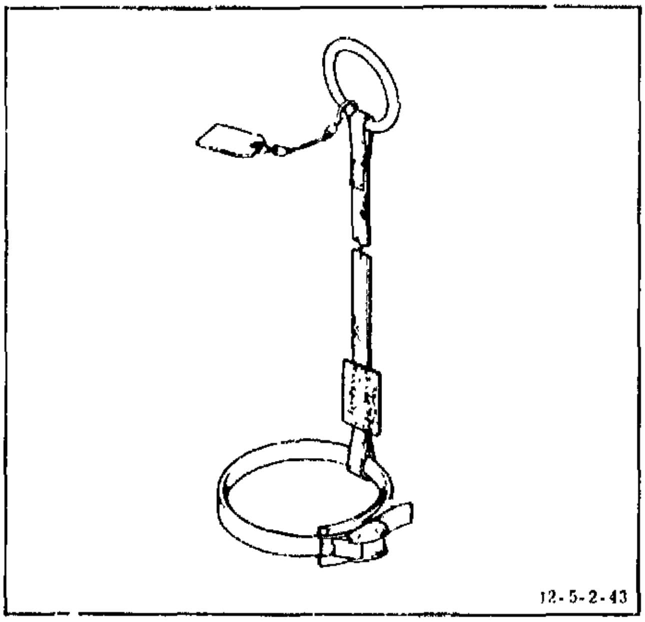



Figure 9-1. Fuel Turbine Exhaust Duct Lifting Sling

| Approved ECP No. | Part Dash Number 9016780 | Incorporated in Manual Dated |
|---|---|---|
| J2-187 | -21 | 28 September 1965 |

Figure 9-2. Configuration Change--Manual Effectivity

## 9-7. DESCRIPTION AND LEADING PARTICULARS OF PROPELLANT INLET DUCT SLING 9024400.

9-8. The propellant inlet duct sling (figure 9-4) is used with an overhead hoist for handling fuel or oxidizer inlet ducts when the ducts are secured within the packaging restraining frames. The sling may be used to lift ducts either in a horizontal or a vertical attitude. The sling consists of three nylon straps attached at one end to a lifting ring. The other ends wrap around the duct and are secured by means of snaps on the straps. The sling is designed for a working load of 190 pounds and is proof-tested at 381 pounds. Information relative to the use of the sling is in Technical Manual R-3825-3.

## 9-9. MAINTENANCE OF START TANK, PROPELLANT INLET DUCT, AND FUEL TURBINE EXHAUST DUCT SLINGS.

9-10. Maintenance tasks required on the slings are listed in figure 9-5. Information presented outlines the tasks to be performed, when the tasks shall be performed, and where the data support for the tasks may be found.

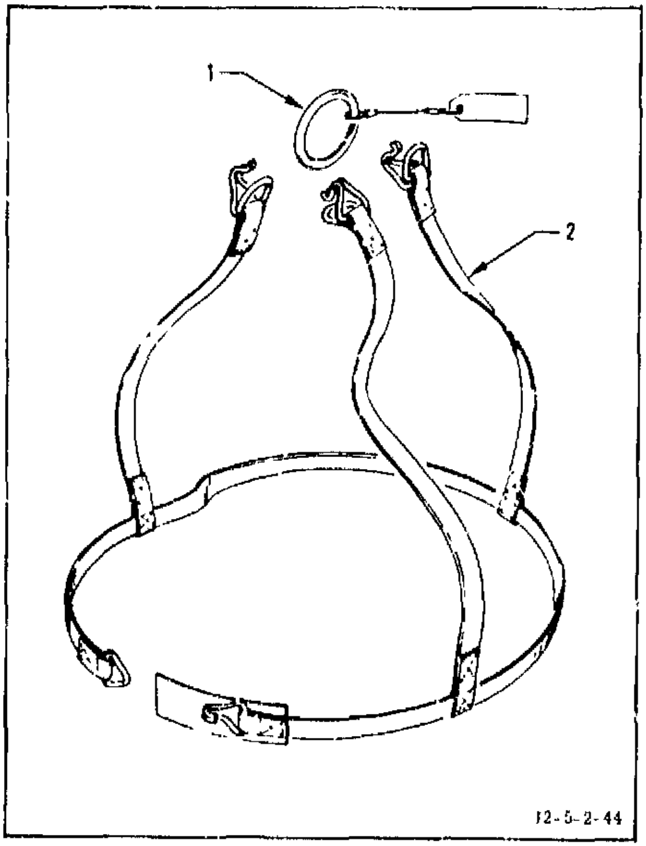



Figure 9-3. Start Tank Sling (Sheet 1 of 2)

| INDEX NO. | PART NUMBER | DESCRIPTION 1 2 3 4 5 6 7 | UNITS PER ASSY. |
|---|---|---|---|
| | 9020265 | SLING ASSY, Start tank . . . . . . . . . . . . . . . . . . . . . | |
| | 9022985 | SLING ASSY, Start tank . . . . . . . . . . . . . . . . . . . . . | |
| 1 | No Number | RING ASSY . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 1 |
| | 492-1/2X5-CAD | . RING (North & Judd Mfg Co) . . . . . . . . . . . . . . . . | 1 |
| | 28-1-C | . SLEEVE (National Telephone Supply Co) . . . . . . . | 2 |
| | RD191-2002-4206 | . CABLE . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | 1 |
| | 9022096 | . IDENTIFICATION PLATE, Lifting strap, . . . . . . . gas spin bottle | 1 |
| | RD171-6016-0001 | . PLATE-IDENT, GSE, Two-line title . . . . . . . . . . . | 1 |
| | RD171-1032-0001 | . PLATE-IDENTIFICATION, Proof load . . . . . . . . | 1 |
| 2 | 9021004 | STRAP, Sling, assy (Used on 9022985) . . . . . . . . . . . | 1 |
| | 9022274 | STRAP, Lifting, assy (Used on 9020265) . . . . . . . . . | 1 |

Figure 9-3. Start Tank Sling (Sheet 2 of 2)

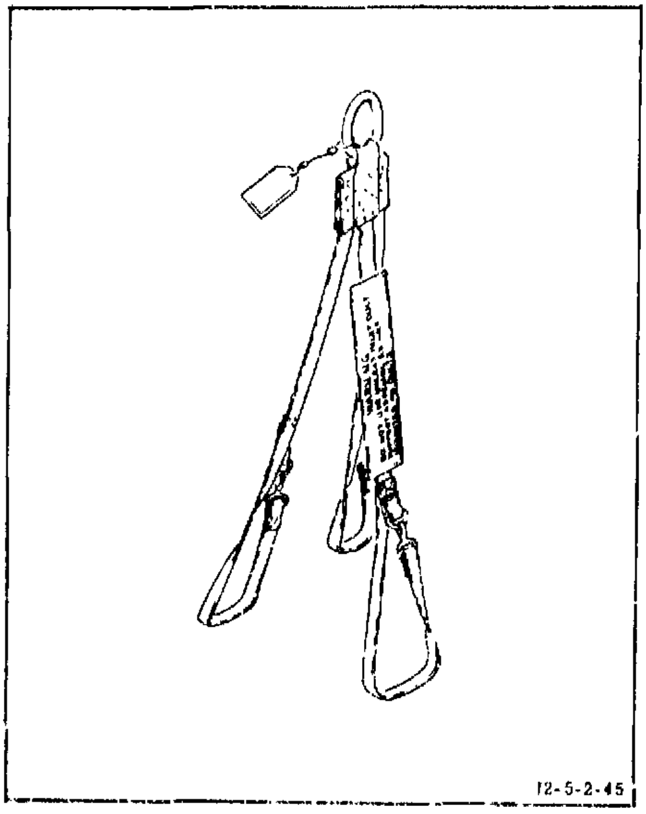



Figure 9-4. Propellant Inlet Duct Sling

9-11. PROOF-TESTING START TANK, PROPELLANT INLET DUCT, AND FUEL TURBINE EXHAUST DUCT SLINGS.

9-12. Proof-testing of a sling consists of lifting and suspending a specially designed weight for a defined period of time. See figure 9-6 for proof-test weight required to test a component sling. To proof-test a component sling, proceed as follows:

a. Attach component sling at black band on proof-test weight. Attach propellant inlet duct sling as shown in figure 9-7.

b. Lift proof-test weight 6 inches and suspend for 5 minutes.

WARNING

Hoisted test weight causes extreme strain on sling. Accelerating, jerking, or traversing the proof-test weight during lifting, lowering, or while suspended can cause undue strain and possible failure of the sling resulting in serious injury to personnel and damage to equipment.

c. Inspect sling for damage after completion of test.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect slings for completeness. | X | X | | | See figures 9-1, 9-3, and 9-4. |
| Inspect straps for frayed, worn, broken straps, or damaged buckles. | X | X | | | Replace sling. |
| Inspect ring for cracks or damage. | X | X | | | Replace sling, except on start tank sling replace ring assembly (see figure 9-3). |
| Inspect fuel turbine exhaust duct lifting sling buckle for loss of positive locking action. | X | X | | | Replace sling. |
| Proof-test sling. | | | | X | Every six months. Refer to paragraph 9-11. |

Figure 9-5. Maintenance Requirements for Start Tank, Propellant Inlet Duct, and Fuel Turbine Exhaust Duct Slings

| Part Number | Sling Nomenclature | Proof-Test Weight |
|---|---|---|
| 9016780 | Fuel Turbine Exhaust Duct Lifting | Exhaust System Sling 9025147 |
| 9020265 | Start Tank | Start Tank Sling 9025149 |
| 9023985 | Start Tank | Start Tank Sling 9025149 |
| 9024400 | Propellant Inlet Duct | Inlet Duct Sling 9025148 |

Figure 9-6. Sling Proof-Test Weight Requirements

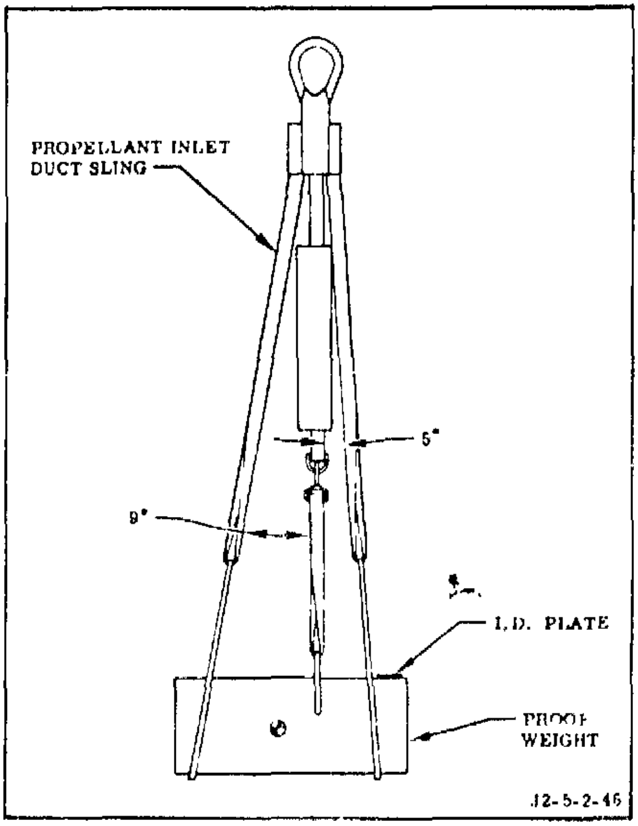



Figure 9-7. Propellant Inlet Duct Sling Proof-Test

9-13. DESCRIPTION AND LEADING PARTICULARS OF COMPONENT HANDLER UNIVERSAL LIFTING SLING 9016779.

9-14. The component handler universal lifting sling (figure 9-8) is used in conjunction with one of several component handlers and with an overhead hoist to remove or install engine components. The sling consists of a tubular adapter, attached to a hoisting ring, and a quick-release pin. The sling is attached to a component handler by inserting the tubular adapter into the handler socket and securing with the quick-release pin. The sling has a working load of 195 pounds and is proof-tested to 390 pounds. Information relative to the use of the sling is found in Technical Manual R-3825-3.

9-15. MAINTENANCE OF COMPONENT HANDLER UNIVERSAL LIFTING SLING.

9-16. Maintenance tasks required on the sling are listed in figure 9-9. Information presented lists the tasks to be performed, when the tasks are to be performed, and where the data support for the tasks will be found.

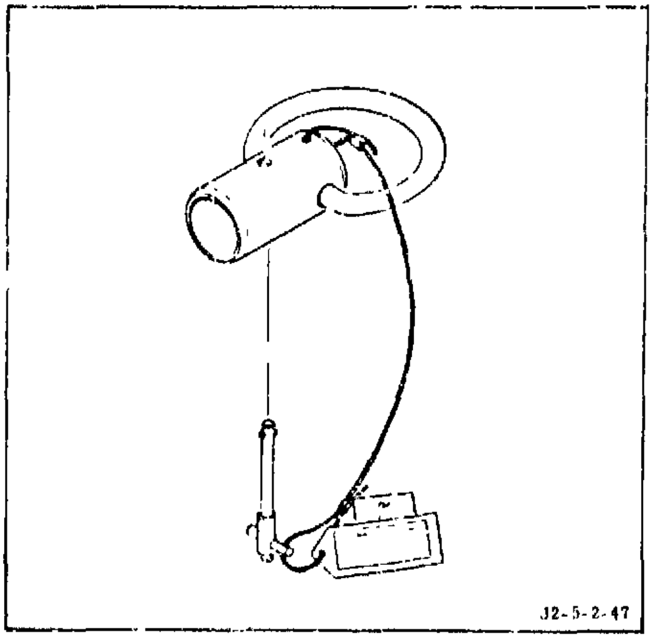



Figure 9-8. Component Handler Universal Lifting Sling

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect sling for completeness. | X | X | | | See figure 9-8. |
| Inspect hoisting ring for cracked weld. | X | X | | | Replace. |
| Inspect quick-release pin for operation. | X | X | | | Lubricate. Refer to R-3825-5, Volume I for lubrication of ball- ock pins. |
| Inspect for frayed or broken cable. | X | X | | | Replace. |
| Clean sling | | | X | | Refer to R-3825-5, Volume I for cleaning requirements. |
| Proof-test sling | | | | X | Every 12 months. Required only on sling to be used within a stacked Saturn vehicle. Proof-test by suspending 390 ±20 lb from sling for a minimum of 3 minutes. |

Figure 9-9. Maintenance Requirements for Component Handler Universal Lifting Sling

All data on pages 9-7 and 9-8 deleted.

# SECTION X

# SPARK MONITOR TURBINE OVERSPEED CUTOFF TEST SET 9024499

**WARNING**

SPARK MONITOR TURBINE OVERSPEED CUTOFF TEST SET 9024499 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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## 10-1. DESCRIPTION AND LEADING PARTICULARS OF SPARK MONITOR TURBINE OVERSPEED CUTOFF TEST SET.

10-2. The spark monitor turbine overspeed cutoff test set (figure 10-1) is used to perform a function-test of the spark monitor and overspeed cutoff panel. The test set consists of a test panel and wire harness mounted in a portable carrying case. The test panel contains test lights, switches, and test jacks on the face of the panel, and the spark simulator, wire harness receptacle, test jacks, and electrical circuitry on the back panel. Mounted on the spark simulator terminal board are resistors, diodes, capacitors, transistors, and interconnecting circuitry. The variable resistors are mounted on the test panel. Quick-release studs attach the test panel to the lower part of the case. The wire harness, an integral part of the test set, is provided with connectors for external power supply, for the spark monitor and overspeed cutoff panel being tested, and for the test panel. A storage compartment for the wire harness has been incorporated into the case. The case cover is detachable to prevent interference when using the test set. A pressure relief valve on the case equalizes internal case pressure with atmospheric pressure. The test set is 21-1/2 inches long, 12 inches wide, 7-1/2 inches deep, and weighs 20 pounds. A 28-volt external power supply is required to operate the test set. The test set is connected to the spark monitor and overspeed cutoff panel being tested. The test set supplies power and simulated spark signals to the

spark monitor and overspeed cutoff panel verifying voltage output signals and circuits. Test equipment is connected in conjunction with the test set activating the spark monitor and overspeed panel cutoff circuits and verifying output circuits. The test set also incorporates circuitry and components to provide for individual checkout of spark exciter monitor circuit boards. Instructions for the use of the spark monitor turbine overspeed cutoff test set are in section VIII.

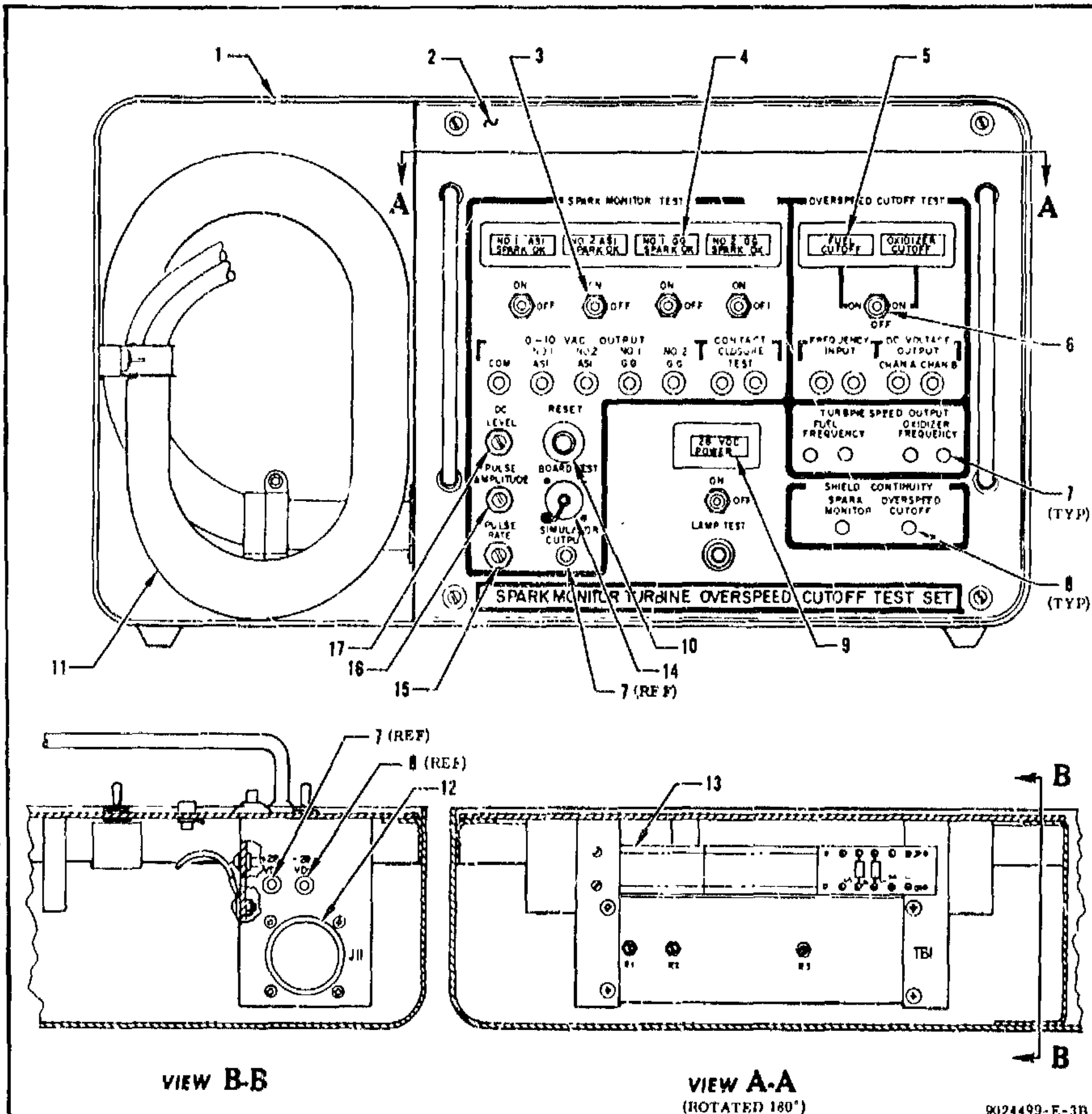



Figure 10-1. Spark Monitor Turbine Overspeed Cutoff Test Set (Sheet 1 of 4)

| Index Number | Part Number | Nomenclature |
|---|---|---|
| | 9024499 | Spark Monitor Turbine Overspeed Cutoff Test Set |
| 1 | 19-9024976 | Case |
| | 7C1-24 | Clamp |
| | AN515C6R12 | Screw |
| | NAS686C06 | Nutplate |
| | 212-12S | Stud Receptacle |
| 2 | 9024980-21 | Panel |
| | 2600-7S | Stud |
| | 2600-LW | Washer |
| 3 | MS35058-24 | Switch |
| 4 | RD415-3004-0001 | Lampholder |
| | RD332-0003-0337 | Lens |
| | RD332-0003-0338 | Lens |
| | RD332-0003-0339 | Lens |
| | RD332-0003-0340 | Lens |
| | RD338-0001-0004 | Filter |
| | RD450-2001-0001 | Control |
| 5 | RD415-3002-0001 | Lampholder |
| | RD332-0003-0342 | Lens |
| | RD332-0003-0343 | Lens |
| | RD338-2001-0001 | Filter |
| | RD450-2001-0001 | Control |
| 6 | MS35059-21 | Switch |
| 7 | 205 | Red Jack (TP2, TP3, TP4, TP5, TP8, TP10, TP11, TP16, TP17, TP19) |
| 8 | 205 | Black Jack (TP1, TP6, TP7, TP9, TP12, TP13, TP15, TP18, TP20) |
| 9 | RD415-3000-0001 | Lampholder |
| | RD332-0003-0341 | Lens |
| | RD338-0001-0004 | Filter |
| | RD450-2001-0001 | Control |

Figure 10-1. Spark Monitor Turbine Overspeed Cutoff Test Set (Sheet 2 of 4)

| Index Number | Part Number | Nomenclature |
|---|---|---|
| 10 | MS25089-3C | Switch |
| 11 | 9024981-21 | Wire Harness |
| | 9025779[a] | Exciter Card Test Cable |
| | AN520C10R7 | Screw |
| | NAS679C3W | Nut |
| | LD153-0010-0007 | Washer |
| | NAS1397R16B | Clamp |
| | 9019615-21 | Simulator |
| | AN515C8R16 | Screw |
| | NAS43DD3-32 | Spacer |
| | LD153-0010-0005 | Washer |
| | NAS679C08W | Nut |
| | 31900 | Terminal Lug |
| | AN515C10R8 | Screw |
| | LD153-0010-0007 | Washer |
| | MS35333-39 | Washer |
| | NAS679C3W | Nut |
| | 3485-2 | Standoff |
| | AN515C6R5 | Screw |
| | MS35337-3 | Washer |
| 12 | MS3102R28-21P | Connector |
| | AN515C6R7 | Screw |
| | LD153-0010-0004 | Washer |
| | NAS679C06W | Nut |
| 13 | 1405-63 | Terminal Board |
| | RC206R103J | Resistor |
| | AN515-2-16 | Screw |
| | NAS42DD3-36 | Spacer |
| | LD153-0011-0002 | Washer |
| | MS35337-39 | Washer |
| | AN340-2 | Nut |
| 14 | MS3112E12-10S | Connector |
| | MS3181-12C | Dust Cap |
| | AN515C4R7 | Screw |
| | LD153-0011-0006 | Washer |
| | NAS679A04W | Nut |

(a) Stow in wire harness storage compartment

Figure 10-1. Spark Monitor Turbine Overspeed Cutoff Test Set (Sheet 3 of 4)

| Index Number | Part Number | Nomenclature |
|---|---|---|
| 15 | RV5LAYSB503A | Resistor |
| 16 | RV5LAYSB251A | Resistor |
| 17 | RV5LAYS103A | Resistor |

Figure 10-1. Spark Monitor Turbine Overspeed Cutoff Test Set (Sheet 4 of 4)

## 10-3. CONFIGURATION CHANGES--MANUAL EFFECTIVITY.

10-4. Configuration changes to the spark monitor turbine overspeed cutoff test set are listed in figure 10-2.

| Approved ECP No. | Part Dash No. | Incorporated In Manual Dated |
|---|---|---|
| J2-325 | 9024499<br>-11 | 30 July 1965 |
| J2-377 | -21 | 19 October 1965 |

Figure 10-2. Configuration Changes--Manual Effectivity

## 10-5. MAINTENANCE OF SPARK MONITOR TURBINE OVERSPEED CUTOFF TEST SET.

10-6. Planned maintenance required to ensure operation of the spark monitor turbine overspeed cutoff test set is listed in figure 10-3. This figure lists the task to be performed, when the tasks are to be performed, and where the data support for the tasks will be found. See figure 10-1 for component identification and figure 10-4, step 1, for a list of the test equipment required for function-testing.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect test set for completeness | X | X | | | See figure 10-1. |
| Inspect case for broken latches and handle | X | X | | | Replace case. See figure 10-1. |
| Inspect case for damaged seal | X | X | | | Replace case. See figure 10-1. |
| Inspect wire harness connector for absence of protective caps | X | X | | | Clean Refer to R-3825-5, Volume I. |
| Inspect wire harness for broken or frayed insulation, broken wires, broken connectors | X | X | | | Repair wire harness. Refer to paragraph 10-18. |
| Inspect test panel for scratches and chipped paint | X | X | | | Painted damaged surface. Refer to paragraph 10-17. |
| Inspect test panel for broken test lamp, switches, and jacks | X | X | | | Remove and replace damaged component. Refer to paragraphs 10-15 and 10-16. |
| Function-test spark monitor turbine overspeed cutoff test set | | | | X | Every 12 months or suspected malfunction. Refer to paragraph 10-7. |
| Clean test set | | | X | | Refer to R-3825-5, Volume I. |
| Prepare test set for storage | | | X | | Refer to paragraph 10-20. |

Figure 10-3. Maintenance Requirements for Spark Monitor Turbine Overspeed Cutoff Test Set

10-7. FUNCTION-TESTING SPARK MONITOR TURBINE OVERSPEED CUTOFF TEST SET.

10-8. The function-tests of the test set consist of a continuity test, lamp circuitry test, and a simulator adjustment test. To function-test and adjust the test set, proceed to figure 10-4. Refer to test set electrical schematic, figure 10-5, and wiring diagram, figure 10-6, as an aid in isolating malfunctions. If results other than those specified are obtained, terminate the test and replace malfunctioning component.

| Step | Operation | Results |
|---|---|---|
| 1 | Obtain the following test equipment:<br>(a) Voltohmmeter, Model 260, (Simpson), or equivalent.<br>(b) Oscilloscope, Model 535 with 53/54C plug-in unit, (Tektronix), or equivalent.<br>(c) Power supply, 22-32 vdc with less than 2-percent ripple under a load of 3 amperes; and regulation within one percent.<br>(d) Differential DC Voltmeter, Model 801 (John Fluke Co), or equivalent.<br>(e) Frequency counter recorder 7150 (Beckman), or equivalent.<br>(f) Voltmeter, VTVM, 1803-B, General Electric, or equivalent. | |
| 1A | Whenever this test requires adjusting a potentiometer, loosen locknuts to make adjustments, then retighten sufficiently to prevent inadvertent movement of adjustment screw. Results must be obtained with locknuts tightened. | |
| 2 | Remove test set case cover. | |

Figure 10-4. Function-Testing Spark Monitor Turbine Overspeed Cutoff Test Set (Sheet 1 of 7)

| Step | Operation | Results |
|---|---|---|
| 3 | Remove test panel. Refer to paragraph 10-13 but do not disconnect wire harness from test set. | |
| 4 | Connect exciter card test cable to BOARD TEST connector on test panel. Check continuity between the following connector pins and test jacks:<br>(a) P1-L and COM test jack.<br>(b) P1-L and P4-D.<br>(c) P3-J and No. 1 ASI test jack.<br>(d) P3-K and No. 2 ASI test jack.<br>(e) P3-L and No. 1 GG test jack.<br>(f) P3-M and No. 2 GG test jack.<br>(g) P3-N and SHIELD CONTINUITY SPARK MONITOR test jack.<br>(h) P1-J and CONTACT CLOSURE TEST left test jack.<br>(i) P1-K and CONTACT CLOSURE TEST right test jack.<br>(j) P4-G and DC VOLTAGE OUTPUT CHAN A. test jack.<br>(k) P4-H and DC VOLTAGE OUTPUT CHAN B. test jack.<br>(l) P4-J and SHIELD CONTINUITY OVERSPEED CUTOFF test jack. | Less than 1 ohm. |

Figure 10-4. Function-Testing Spark Monitor Turbine Overspeed Cutoff Test Set (Sheet 2 of 7)

| Step | Operation | Results |
|---|---|---|
| 4 (cont) | (m) Move OVERSPEED CUTOFF TEST switch to FUEL CUTOFF ON. Check continuity between P4-E and FREQUENCY INPUT red test jack. | |
| | (n) P4-F and FREQUENCY INPUT black test jack. | |
| | (o) Move OVERSPEED CUTOFF TEST switch to OXIDIZER CUTOFF ON. Check continuity between P4-B and FREQUENCY INPUT red test jack. | |
| | (p) P4-A and FREQUENCY INPUT black test jack. | |
| | (q) Move OVERSPEED CUTOFF TEST switch to OFF. | |
| | (r) E1 ground terminal on wire harness and panel lifting handle. | |
| | (s) P5-A and FUEL FREQUENCY red test jack. | |
| | (t) P5-B and FUEL FREQUENCY black test jack. | |
| | (u) P5-C and OXIDIZER FREQUENCY red test jack. | |
| | (v) P5-D and OXIDIZER FREQUENCY black test jack. | |
| | (w) P5-F and SHIELD CONTINUITY OVERSPEED CUTOFF black test jack. | |
| | (x) PI-L and J31-B | |
| | (y) PI-L and PI-B | |
| | (z) P3-J and J31-F | |
| | (aa) J31-H and J31-K | |

Figure 10-4. Function-Testing Spark Monitor Turbine Overspeed Cutoff Test Set (Sheet 3 of 7)

| Step | Operation | Results |
|---|---|---|
| 5 | Check resistance between the following connector pins and test jacks.<br>(a) FUEL FREQUENCY red test jack and black test jack.<br>(b) OXIDIZER FREQUENCY red test jack and black test jack.<br>(c) P5-A and P5-B.<br>(d) P5-C and P5-D. | 10,000 ±500 ohms. |
| 6 | Connect P50 to 28 vdc facility power supply. | None. |
| 7 | Energize and adjust facility power supply. | 28 ±2 vdc. |
| 8 | Depress LAMP TEST switch momentarily. | All lights on momentarily. |
| 9 | Move 28 VDC POWER switch to ON. | 28 VDC POWER light on. |
| 10 | Measure voltage between 28 VDC and -28 VDC test jacks. (Test jacks are located on connector J11 bracket.) | 28 ±2 vdc. |
| NOTE: The test panel may be installed into the case. (Refer to paragraph 10-14.) | | |
| 11 | Connect a test lead from PI-M to P2-I. | No. 1 ASI SPARK OK light on. |
| 12 | Remove test lead from P2-I and connect it to J21-A. | (a) No. 1 ASI SPARK OK light off.<br>(b) No. 1 ASI SPARK OK light on. |
| 12A | Remove test lead from J21-A and connect it to P2-F. | (a) No. 1 ASI SPARK OK light off. |

Figure 10-4. Function-Testing Spark Monitor Turbine Overspeed Cutoff Test Set (Sheet 4 of 7)

| Step | Operation | Results |
|---|---|---|
| 12A (cont) | | (b) No. 2 ASI SPARK OK light on. |
| 13 | Remove test lead from P2-F and connect it to P2-G. | (a) No. 2 ASI SPARK OK light off.<br>(b) No. 1 GG SPARK OK light on. |
| 14 | Remove test lead from P2-G and connect it to P2-C. | (a) No. 1 GG SPARK OK light off.<br>(b) No. 2 GG SPARK OK light on. |
| 15 | Remove test lead from P2-C and connect it to P4-G. | (a) No. 2 GG SPARK OK light off.<br>(b) FUEL CUTOFF light on. |
| 16 | Check voltage between DC VOLTAGE OUTPUT CHAN A and COM test jacks. | 28 ±2 vdc. |
| 17 | Remove test lead from P4-G and connect it to P4-H. | (a) FUEL CUTOFF light off.<br>(b) OXIDIZER CUTOFF light on. |
| 18 | Check voltage between DC VOLTAGE OUTPUT CHAN B and COM test jacks. | 28 ±2 vdc. |
| 18A | Remove test lead from P4-H and P1-M. | OXIDIZER CUTOFF light off. |
| 19 | Check voltage between the following connectors and pins:<br>(a) P4-C (Positive) and P4-D.<br>(b) P1-M (Positive) and P1-L.<br>(c) J31-E (Positive) and COM test jack. | 28 ±2 vdc |

Figure 10-4. Function-Testing Spark Monitor Turbine Overspeed Cutoff Test Set (Sheet 5 of 7)

| Step | Operation | Results |
|---|---|---|
| 20 | Move 28 VDC POWER switch to OFF and deenergize power supply. | 28 VDC POWER light off. |
| NOTE: Steps 21 through 24 adjust potentiometers. | | |
| 21 | (Deleted) | |
| 22 | Connect VTVM, frequency counter and oscilloscope with pre-amp plug-in module to SIMULATOR OUTPUT and COM test jack. Connect negative leads to COM jack. | |
| 23 | Energize test equipment and power supply. Adjust power supply to 28 ±2 vdc. | |
| 24 | Move 28 VDC POWER switch to ON. | (a) 28 VDC POWER light on.<br><br>(b) VTVM indicates 6.5 ±0.06 volts.<br><br>(c) Oscilloscope indicates a 1-2 volt pulse.<br><br>(d) Counter indicates 40 ±1 pulses per second. |
| NOTE: If the results of step 24 are not obtained, perform steps 25 through 27. If the results are obtained, proceed to step 28. | | |
| 25 | Adjust DC LEVEL potentiometer until VTVM indicates 6.5 ±0.06 volts. | |
| 26 | Adjust PULSE AMPLITUDE potentiometer until oscilloscope indicates at 1-2 volt pulse. | |
| 27 | Adjust PULSE RATE potentiometer until frequency counter indicates 40 ±1 pulses per second. | |

Figure 10-4. Function-Testing Spark Monitor Turbine Overspeed Cutoff Test Set (Sheet 6 of 7)

| Step | Operation | Results |
|---|---|---|
| 28 | Move 28 VDC POWER switch to OFF. | (a) 28 VDC POWER light off. (b) Voltage, amplitude, and frequency indications disappear. |
| 29 | Deenergize and disconnect power supply and test equipment. | |
| 30 | Check continuity between J31-L and P3-F. | Continuity. |
| 31 | Check continuity between SPARK SIM OUT and P3-F with NO. 1 ASI SPARK OK switch to ON and to OFF. | Continuity with switch to ON. No continuity with switch to OFF. |
| 32 | Check continuity between SPARK SIM OUT and P3-G with NO. 2 ASI SPARK OK switch to ON and to OFF. | Continuity with switch to ON. No continuity with switch to OFF. |
| 33 | Check continuity between SPARK SIM OUT and P3-H with NO. 1 GG SPARK OK switch to ON and to OFF. | Continuity with switch to ON. No continuity with switch to OFF. |
| 34 | Check continuity between SPARK SIM OUT and P3-I with NO. 2 GG SPARK OK switch to ON and to OFF. | Continuity with switch to ON. No continuity with switch to OFF. |
| 35 | Move NO. 1 and NO. 2 ASI SPARK OK and NO. 1 and NO. 2 GG SPARK OK switches to ON. | None. |
| 36 | Depress and hold RESET switch and check continuity between SPARK SIM OUT and P3-F, P3-G, P3-H, and P3-I. | No continuity. |
| 37 | Install wire harness. (Refer to paragraph 10-14.) | |
| 38 | Install test set case cover. | |

Figure 10-4. Function-Testing Spark Monitor Turbine Overspeed Cutoff Test Set (Sheet 7 of 7)

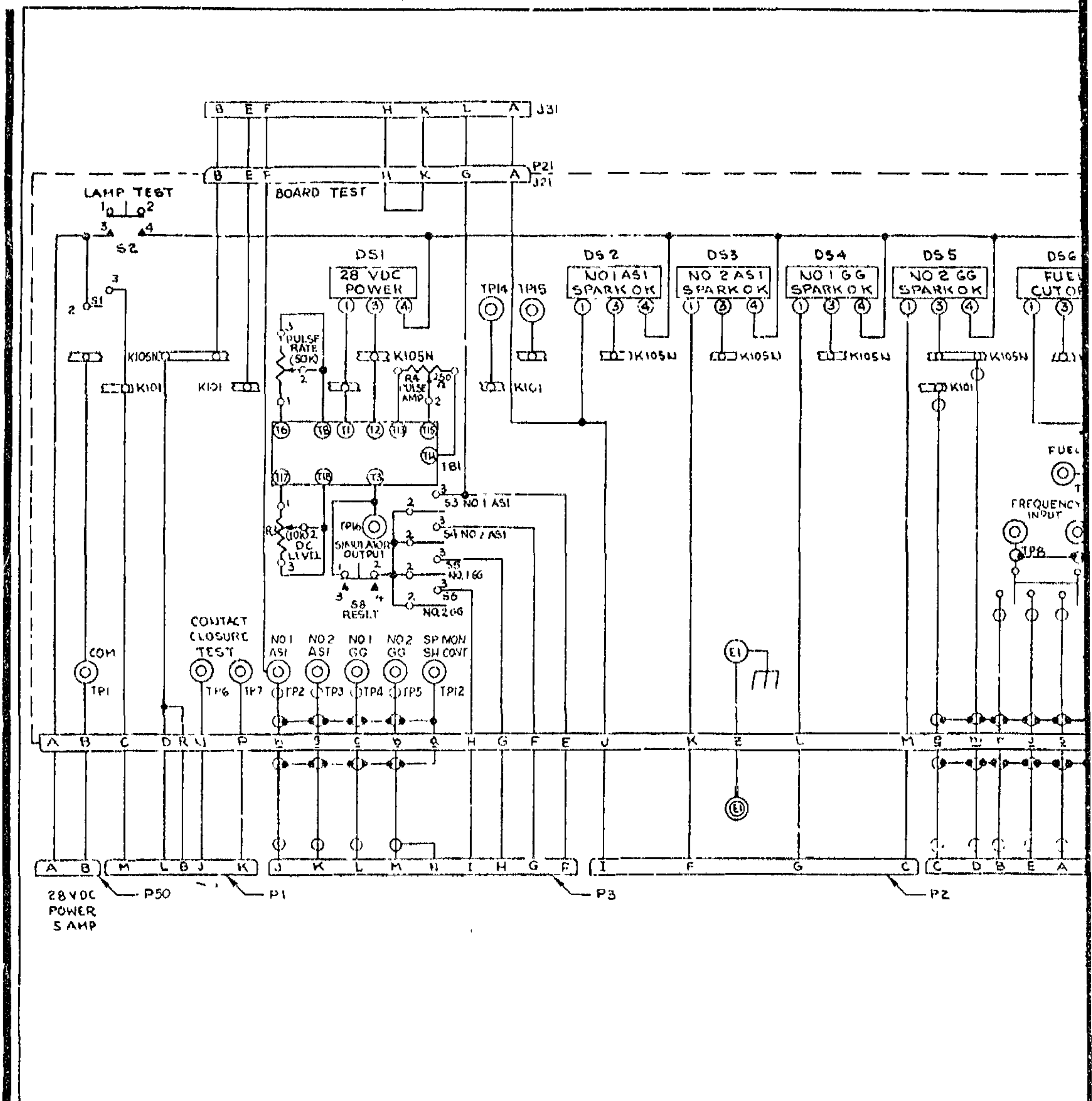
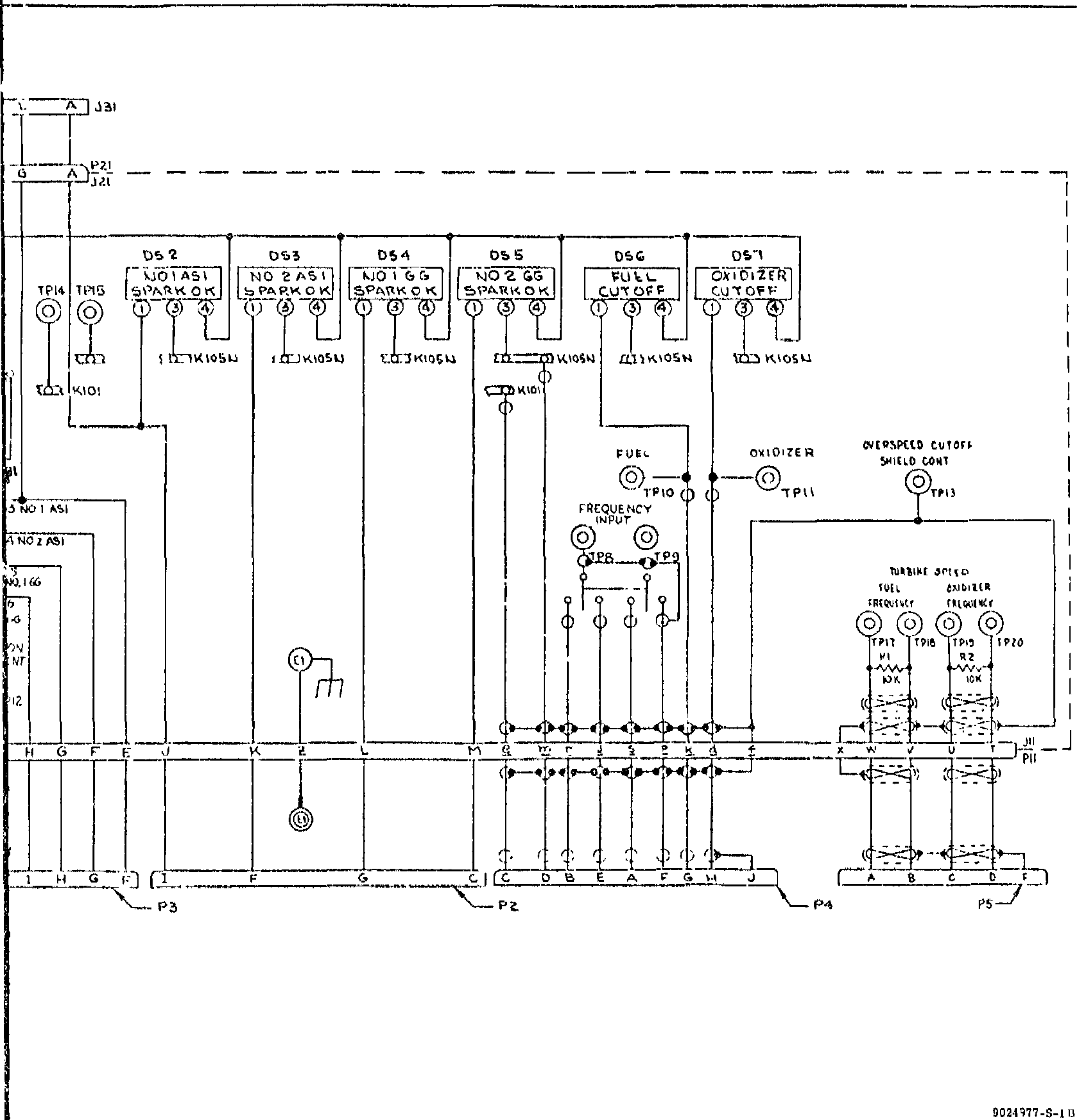



Figure 10-5. Spark Monitor Turbine Overspeed Cutoff Test Set Electrical Schematic




rbine Overspeed Cutoff Test Set
chematic

10-9. STORING SPARK MONITOR TURBINE OVERSPEED CUTOFF TEST SET.

10-10. To prepare the test set for storage, proceed as follows:

a. Clean test panel face, wire harness, test set case exterior, and wire harness storage area interior. Refer to R-3825-5, Volume I.

b. Install protective caps on wire harness electrical connectors.

c. Place test set case cover on test set and secure.

d. Wrap test set with greaseproof barrier material (MIL-B-121, Grade A), or equivalent, and seal.

10-11. MAINTENANCE OF SPARK MONITOR TURBINE OVERSPEED CUTOFF TEST SET COMPONENTS.

10-12. Maintenance of the test set components consists of removing, installing, and replacing test panel components, painting test panel, repairing wire harness, repairing test set case, and preparing components for storage. Replaceable components and attaching hardware are listed in figure 10-1.

10-13. REMOVING TEST PANEL AND WIRE HARNESS. Remove test set test panel and wire harness as follows:

a. Loosen quick-release studs on face of panel.

b. Remove screws securing wire harness duct cover to case.

c. Release wire harness from securing clamp.

d. Remove bolts and clamps attaching wire harness to case.

e. Lift test panel and wire harness from case.

f. Disconnect wire harness from receptacle in back of test panel.

10-14. INSTALLING TEST PANEL AND WIRE HARNESS. Install test set test panel and wire harness as follows:

a. Connect wire harness to test panel receptacle.

b. Install test panel in case and secure with quick-release studs.

c. Install wire harness attaching clamps. Refer to section I for applicable torque.

d. Install wire harness duct cover. Refer to section I for applicable torque.

e. Install wire harness in securing clamp.

10-15. REMOVING TEST PANEL COMPONENTS. To remove test panel components it is necessary to remove test panel from the test set. Remove test panel per paragraph 10-13. No special instructions are required to remove components from the test panel.

10-16. INSTALLING TEST PANEL COMPONENTS. The only instructions required to install test panel components is that a heat sink be used when soldering wires during the terminal board installation. To ensure proper component and wire installation, see figures 10-1 and 10-6. When installing components, refer to section I for applicable torque values. Function-test the test set upon completing the component installation. Refer to paragraph 10-7.

10-17. PAINTING TEST PANEL. Paint test panel with gray enamel (Federal Specification TT-E-529), color 26440 (Federal Standard 595), except for a one-quarter-inch area around ground wire mounting hole in the wire harness receptacle mounting bracket.

10-18. REPAIRING WIRE HARNESS. No special instructions are required to repair the wire harness. See figure 10-7 for wire harness requirements and wiring diagram. Refer to paragraph 10-13 and 10-14 for removing and installing wire harness. Perform function-test per paragraph 10-7 upon completion of wire harness repair.

10-19. REPAIRING TEST SET CASE. Repair of test set case consists of replacing clamps, nutplates, and stud receptacles, and painting. Replaceable components of case are listed in figure 10-1. Paint case exterior with Perma-Resin gray, 170-H-64 (W. P. Fuller Paint Co), or equivalent. Paint case interior with light gray enamel (MIL-E-15090, Type III, Class 2) and bake for 30 minutes at 250° F. Allow one hour after baking for air drying. Handle, pressure relief valve, rubber channel, bumper pads, and latches shall not be painted.

10-20. STORING SPARK MONITOR TURBINE OVERSPEED CUTOFF TEST SET COMPONENTS.

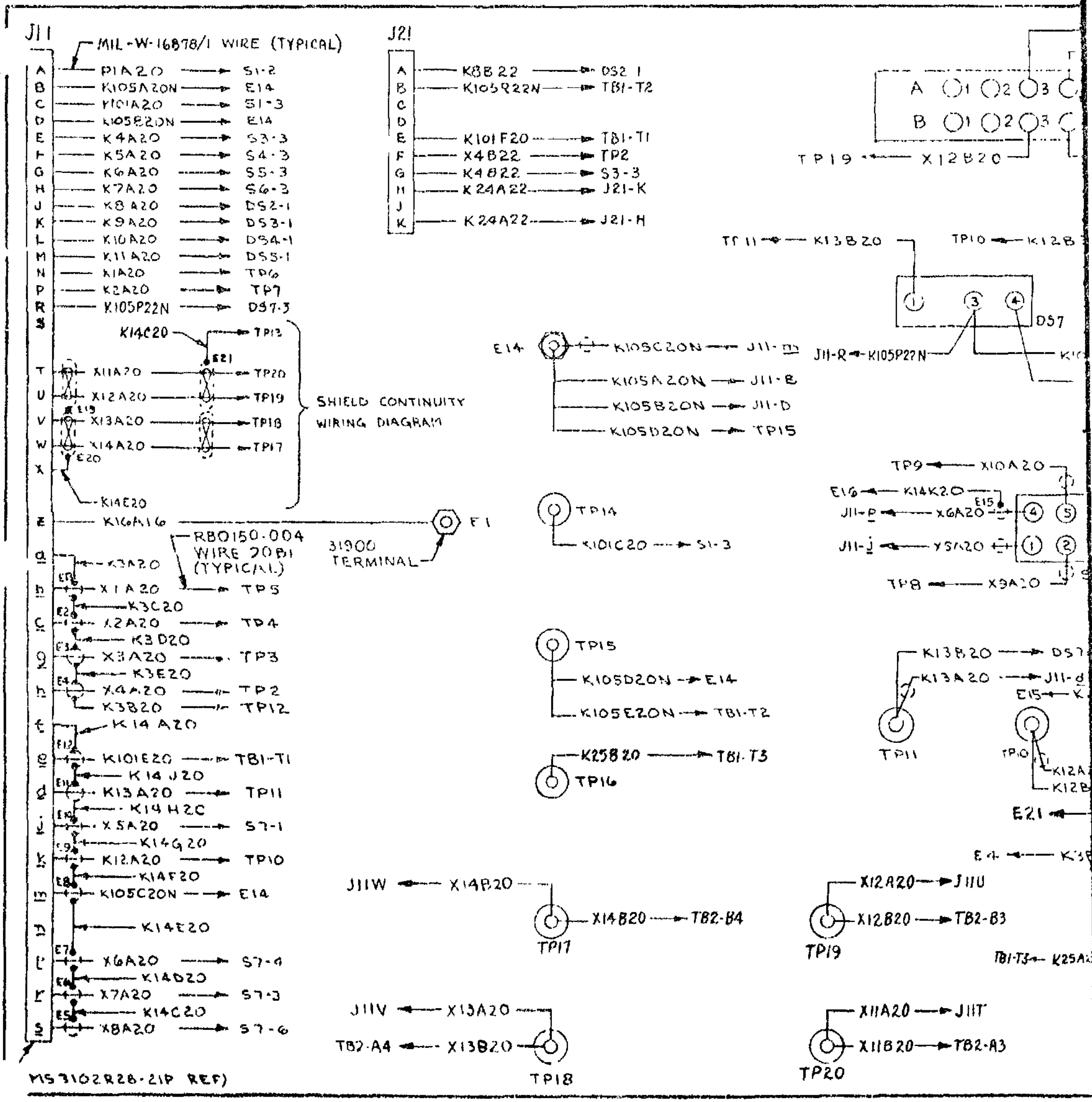
10-21. Prepare test set components for storage as follows:

a. Clean component. Refer to Cleaning of Electrical Components in section I.

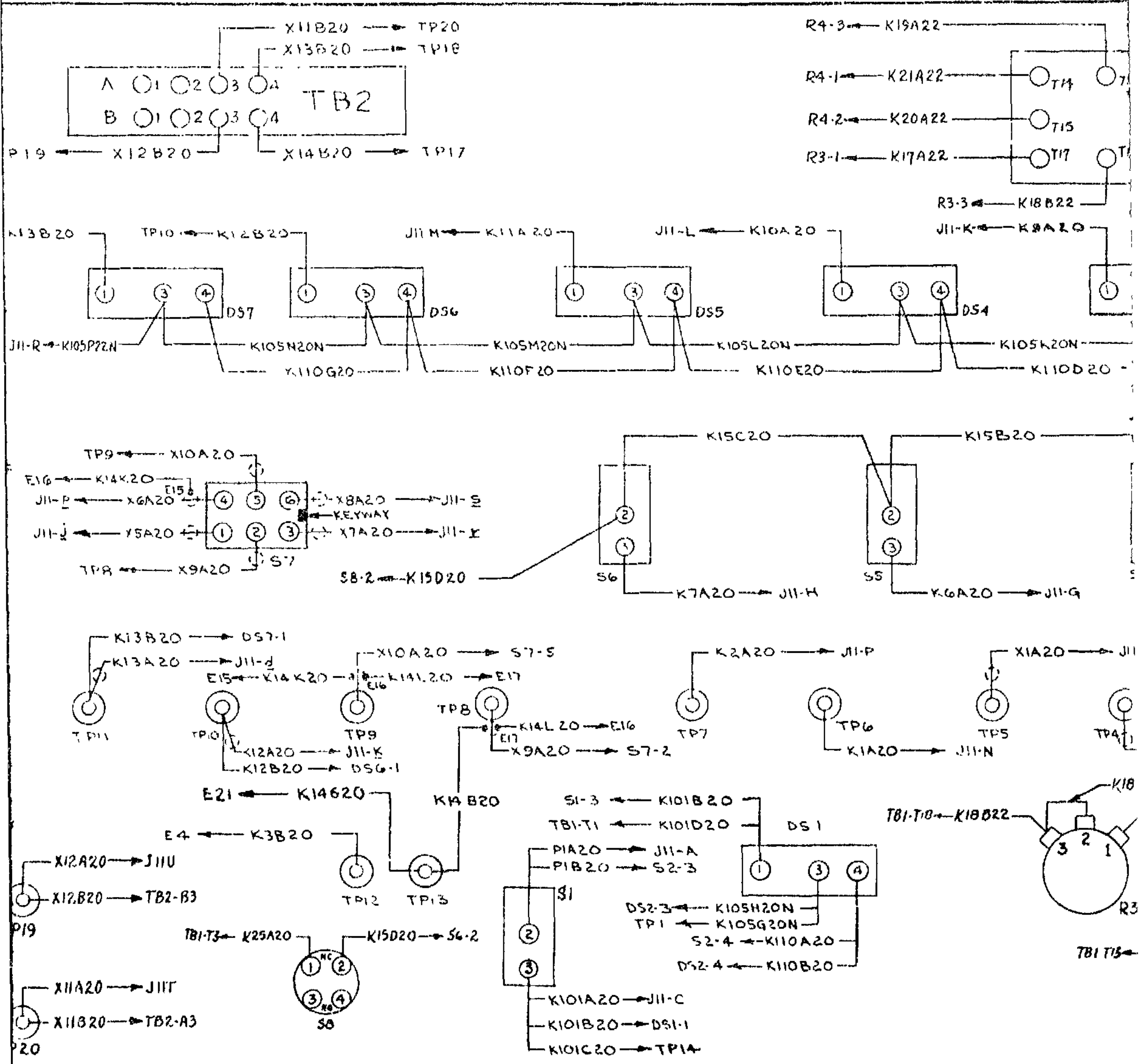
b. Install protective caps on component receptacles.

c. Wrap component with greaseproof barrier material (MIL-B-121, Grade A) and seal.

d. Place wrapped component in a plastic bag and seal.



J11
MIL-W-16878/1 WIRE (TYPICAL)
A P1A20 S1-2
B K105A20N E14
C K101A20 S1-3
D K105B20N E14
E K4A20 S3-3
F K5A20 S4-3
G K6A20 S5-3
H K7A20 S6-3
J K8A20 DS2-1
K K9A20 DS3-1
L K10A20 DS4-1
M K11A20 DS5-1
N K1A20 TP6
P K2A20 TP7
R K105P22N DS7-3
K14C20 TP13
E21
T X11A20 TP20
U X12A20 TP19
V X13A20 TP18
W X14A20 TP17
E19
E20
X
K14E20
SHIELD CONTINUITY WIRING DIAGRAM
Z K16A16 E1
RB0150-004 WIRE 20BI (TYPICAL)
31900 TERMINAL
a K3A20
b X1A20 TP5
K3C20
c X2A20 TP4
K3D20
g X3A20 TP3
K3E20
h X4A20 TP2
K3B20 TP12
K14A20
e K101E20 TB1-T1
K14J20
d K13A20 TP11
K14H20
j X5A20 S7-1
K14G20
k K12A20 TP10
K14F20
m K105C20N E14
K14E20
X6A20 S7-4
K14D20
X7A20 S7-3
K14C20
s X8A20 S7-6
MS3102R28-21P REF)
J21
A K8B22 DS2-1
B K105R22N TB1-T2
C
D
E K101F20 TB1-T1
F X4B22 TP2
G K4B22 S3-3
H K24A22 J21-K
J
K K24A22 J21-H
E14
K105C20N J11-m
K105A20N J11-B
K105B20N J11-D
K105D20N TP15
E1
TP14
K101C20 S1-3
TP15
K105D20N E14
K105E20N TB1-T2
K25B20 TB1-T3
TP16
J11W X14B20
X14B20 TB2-B4
TP17
J11V X13A20
TB2-A4 X13B20
TP18
A 1 2 3
B 1 2 3
TP19 X12B20
TP11 K13B20
TP10 K12B
DS7
J11-R K105P22N
TP9 X10A20
E16 K14K20
E15
J11-P X6A20
J11-j X5A20
TP8 X9A20
K13B20 DS7
K13A20 J11-d
E15
TP11
TP10
K12A
K12B
E21
E4 K3
X12A20 J11U
X12B20 TB2-B3
TP19
TB1-T3 K25A
X11A20 J11T
X11B20 TB2-A3
TP20



TB2
X11B20 TP20
X13B20 TP18
X12B20
X14B20 TP17
R4-3 K19A22
R4-1 K21A22 T14
R4-2 K20A22 T15
R3-1 K17A22 T17
R3-3 K18B22
DS7
DS6
DS5
DS4
K105N20N
K105M20N
K105L20N
K105K20N
K110G20
K110F20
K110E20
K110D20
J11-R K105P22N
K15C20
K15B20
S7
S6
S5
S8-2 K15D20
K7A20 J11-H
K6A20 J11-G
KEYWAY
TP1
TP7
TP6
TP5
TP9
TP10
TP11
TP12
TP13
E21 K14620
K14B20
E4 K3B20
DS1
S1
S8
P19
P20
TB1-T3 K25A20
K15D20 S6-2
TB1-T18 K18B22
TB1 T15
K101A20 J11-C
K101B20 DS1-1
K101C20 TP14


Figure 10-6.

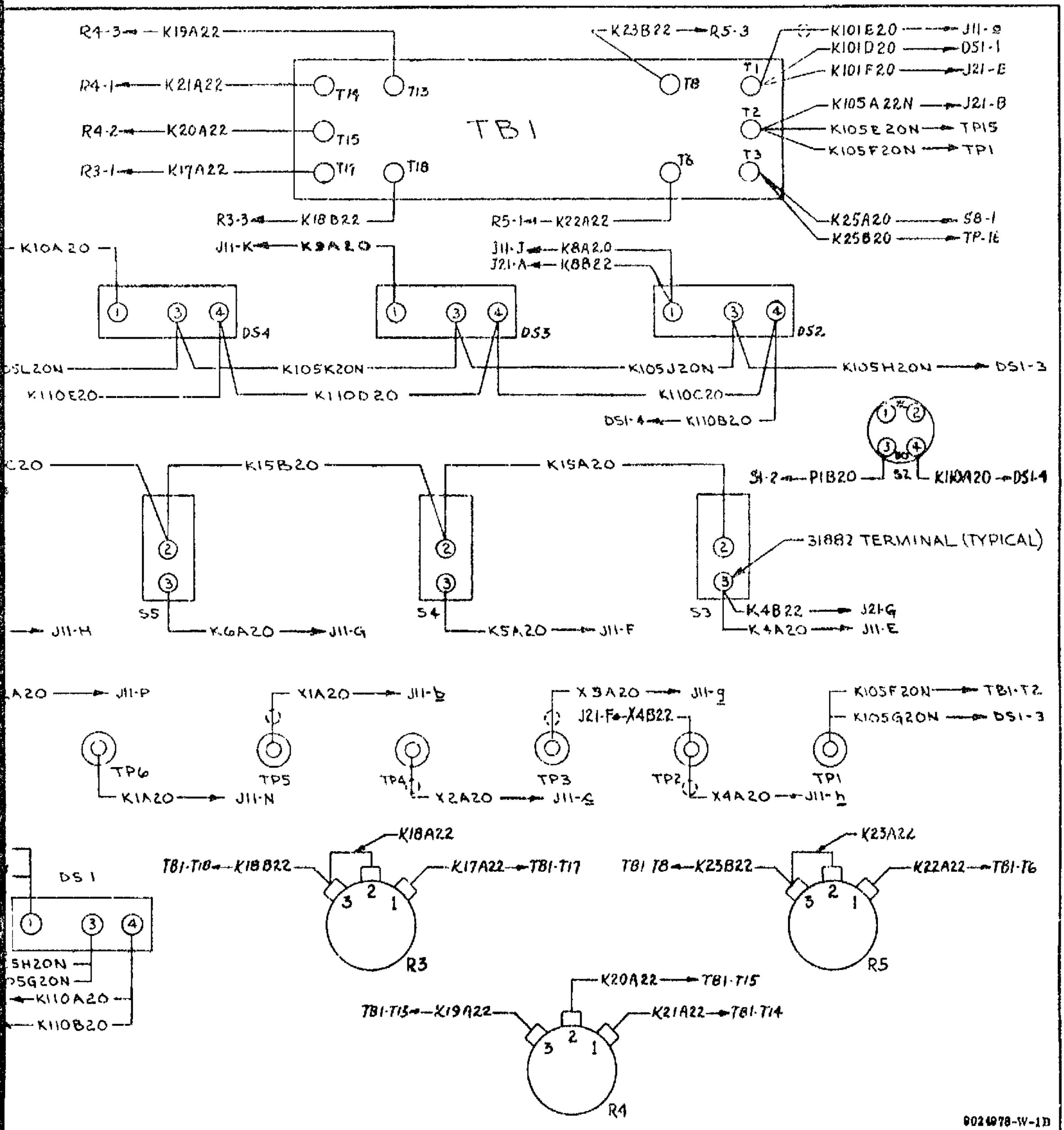



Figure 10-6. Spark Monitor Turbine Overspeed Cutoff Test Panel Wiring Diagram

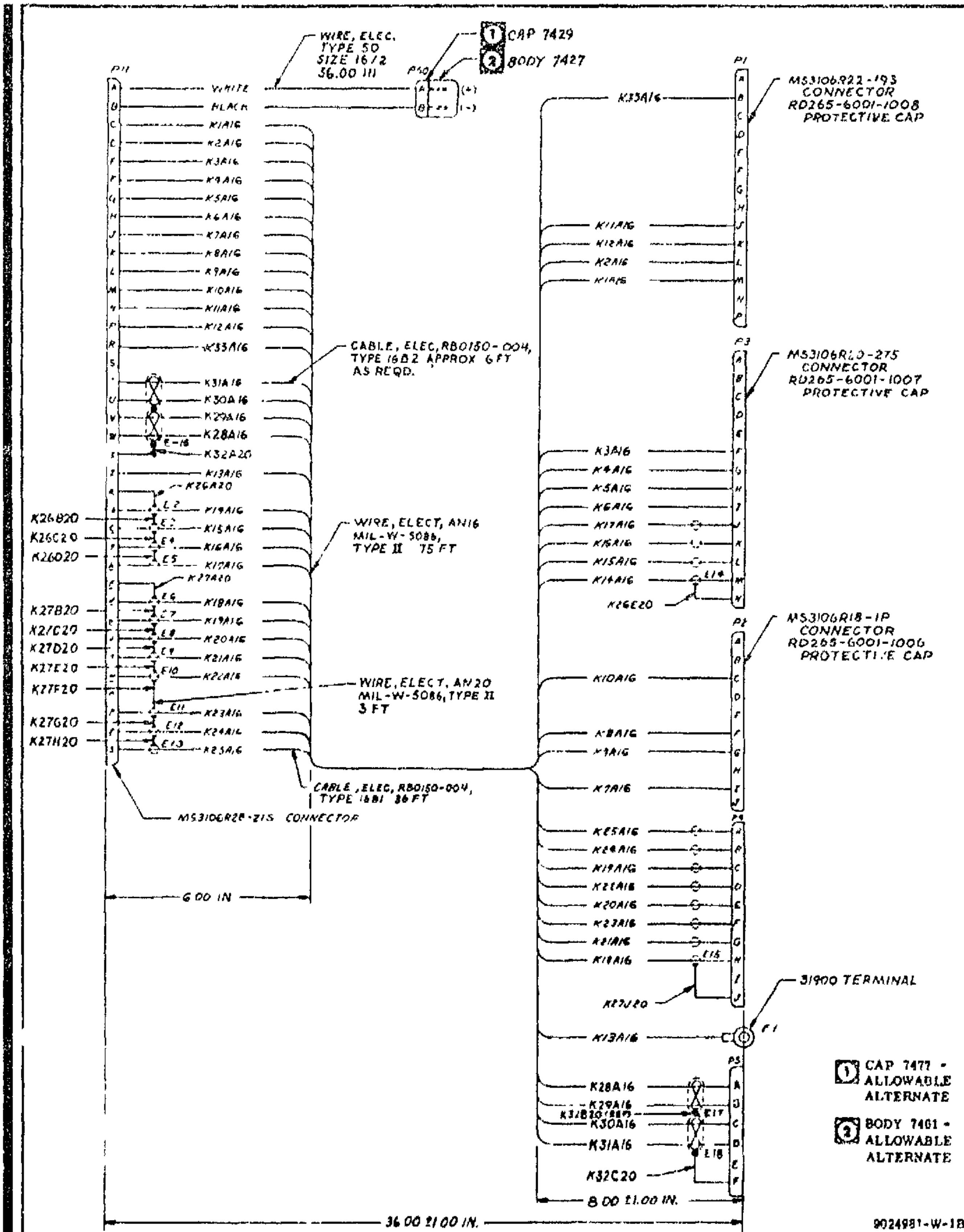


Figure 10-7. Spark Monitor Turbine Overspeed Cutoff Test Set Wire Harness

All data on pages 10-19 and 10-20 deleted.

# SECTION XI

# IGNITION DETECTOR SET 99-9026355

## WARNING

IGNITION DETECTOR SET 99-9026355 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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## 11-1. DESCRIPTION AND LEADING PARTICULARS OF IGNITION DETECTOR SET.

11-2. The ignition detector set (figure 11-1) is a temperature sensing system designed to detect ignition in the augmented spark ignition chamber on the engine and send the signal to the engine electrical control package and the facility test center. The ignition detector set consists of a differential temperature sensing transducer, ignition detector, and interconnecting electrical harness. The transducer contains two resistance elements, one embedded in the transducer body and one protruding into the combustion chamber. The transducer replaces the ignition detector probe normally installed in the augmented spark ignition chamber ignition detector probe housing. The ignition detector consists of a transistorized differential amplifier operating a voltage sensitive transistor switch with a relay load. The amplifier and switch are incorporated into an electrical box with three receptacles. An access is provided under the mounting plate of the ignition detector for resistor adjustment. A jumper plug on one of the receptacles provides a calibration receptacle when the jumper plug is removed. The electrical harness interconnects the ignition detector with the transducer and the engine electrical harness. The

ignition detector set is connected to the test stand by a facility supplied electrical harness. See figure 11-2 for leading particulars.

11-3. THEORY OF OPERATION FOR IGNITION DETECTOR SET.

11-4. When ignition occurs, the transducer element in the combustion chamber senses a higher temperature resulting in a resistance unbalance between the two elements. This resistance unbalance is sensed in the ignition detector which will signal ignition detected if the unbalance exceeds 10 ohms. When detection occurs, a relay in the ignition detector causes a 100-ohm change in the resistor network which is connected to the engine electrical control assembly. The 100-ohm change is greater than the 35-ohm change required by the engine electrical control assembly to disarm the ignition detector cutoff circuit and permit engine mainstage operation.

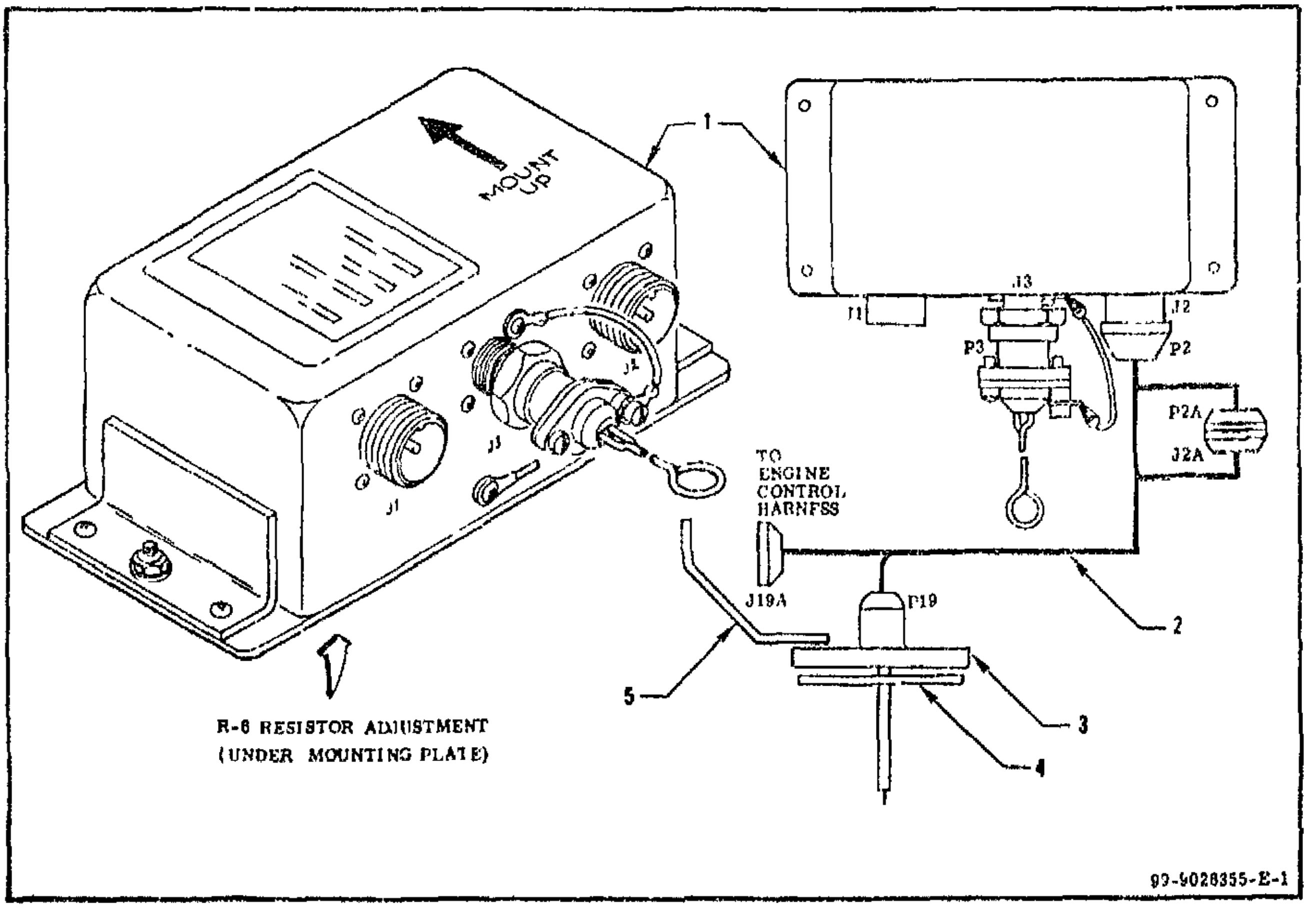



Figure 11-1. Ignition Detector Set (Sheet 1 of 2)

| Index Number | Part Number | Nomenclature | Source and Recoverability Code (Refer to section I.) |
|---|---|---|---|
| | 99-9026355 | Ignition Detector Set | F-1 |
| 1 | 99-9026356 | Ignition Detector Calibration Chart | F-2 |
| | 99-9026364 | Jumper Plug | F-1 |
| | NAS1201C6A | Fitting | F-3 |
| | RB0150-019 | Electrical Wire | F-3 |
| | RD414-1009-0005 | Connector | F-3 |
| | RD191-2003-0005 | Wire Rope | F-3 |
| 2 | 99-9026357 | Wire Harness | M-1 |
| | MS3101R14S-6P | Connector (J19A) | F-3 |
| | RB0150-015, Type 163B | Electrical Cable | F-3 |
| | RB0150-019, 16 Gauge | Electrical Wire | F-3 |
| | RD414-1006-0002 | Connector (P2A) | F-3 |
| | RD414-1009-0025 | Connector (P2) | F-3 |
| | RD414-1009-0014 | Connector (P19) | F-3 |
| | RD414-1011-0002 | Connector (J2A) | F-3 |
| 3 | NA5-27298T2 | Transducer | F-2 |
| 4 | 408767-3 | Seal | F-3 |
| 5 | 557415 | Bracket | F-3 |

Figure 11-1. Ignition Detector Set (Sheet 2 of 2)

| | |
|---|---|
| Ignition Detector | |
| Length | 8.76 inches |
| Width | 4.12 inches |
| Depth | 3.25 inches |
| Power Requirement | 24-30 vdc<br>15 watts, maximum |
| Analog Output | 9-16 vdc<br>100,000 ohms load impedance, minimum |
| Simulate Input | 20-30 vdc<br>20 milliamperes, maximum |
| Ignition Detected Output | 20-30 vdc<br>333 milliamperes, maximum |
| Transducer Resistance | 100 ohms, ±2 ohms at 32° F |
| Electrical Harness | |
| Length | 20 feet |

Figure 11-2. Leading Particulars for Ignition Detector Set

## 11-5. MAINTENANCE OF IGNITION DETECTOR SET.

11-6. Planned field maintenance required to ensure operation of the ignition detector set is listed in figure 11-3. This figure outlines the tasks to be performed, when the tasks shall be performed, and where the data support for these tasks will be found. See figure 11-1 for identification of components and figure 11-5 for a list of test equipment required for function-testing the ignition detector set.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect ignition detector set for completeness. | X | X | | | See figure 11-1. |
| Inspect ignition detector adjustment for broken torque stripe. | X | X | | | Function-test per paragraph 11-11. |
| Inspect wire harness connectors, ignition detector receptacles and transducer receptacle for absence of protective caps. | X | X | | | Clean. Refer to Cleaning Electrical Components in section I. |
| Inspect wire harness for broken or frayed insulation, broken wires. | X | X | | | Repair wire harness. Refer to paragraph 11-15. |
| Inspect transducer sealing surface for nicks and scratches. | X | X | | | Replace transducer. |
| Inspect transducer seal for nicks and scratches. | X | X | | | Replace seal. |
| Function-test ignition detector set. | X | | | X | Every 6 months or suspected malfunction. Refer to paragraph 11-9. |

Figure 11-3. Maintenance Requirements for Ignition Detector Set (Sheet 1 of 2)

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Test transducer. | X | | | X | Every 6 months or suspected malfunction. Refer to paragraph 11-12. |
| Clean ignition detector set. | | | X | | Refer to Cleaning Electrical Components in section I. |
| Prepare ignition detector set for storage or shipment. | | | X | | Refer to paragraph 11-13. |

Figure 11-3. Maintenance Requirements for Ignition Detector Set (Sheet 2 of 2)

## 11-7. INSTALLATION REQUIREMENTS FOR IGNITION DETECTOR SET.

11-8. Function-test the ignition detector set before installation. Refer to paragraph 11-9. Requirements for installing the set are given in figure 11-4. See figure 11-1 for connector identification.

| Requirements | Location | Remarks |
|---|---|---|
| Detector Set | Facility Test Stand | Within 15 feet of engine. |
| Cable | P1 to facility | Cable required to supply power and transmit signals. |
| 20-30 vdc, current limited to 333 milliamperes, maximum | P1-J to facility | Ignition detector output. |
| 20-30 vdc, 20 milliamperes, maximum | P1-C to facility | Simulate input. |

Figure 11-4. Installation Requirements for Ignition Detector Set (Sheet 1 of 2)

| Nomenclature | Requirement | Use |
|---|---|---|
| Voltmeter | Indicate 8-30 volts with one % accuracy. Minimum input impedance is 100 000 ohms. | To measure voltage during function-test. |
| Megger | Supply 45-55 vdc maximum. Measure insulation resistance within ±14.0%. | To test transducer for insulation break-down. |
| Decade Box (2 required) | Vary resistance from 0-500 ohms in 0.1-ohm increments with ±0.5% accuracy. | To vary resistance to ignition detector during test. |
| Resistance Bridge | Measure resistance to 500 ohms with ±0.5% accuracy. | To measure output of ignition detector. |
| Lamps (2 required) | 28-vdc, 125-ohm resistance, minimum. | To indicate electrical flow during tests. |
| Switches (3 required) | Single pole, single throw. | To control electrical flow during tests. |

Figure 11-5. Test Equipment for Ignition Detector Set (Sheet 2 of 2)

11-11. FUNCTION-TESTING AND ADJUSTING IGNITION DETECTOR. To function-test and adjust the ignition detector, proceed to figure 11-6.

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 1 | | Obtain test equipment (figure 11-5). | | |
| NOTE: Allow all test equipment to warm up for fifteen minutes. | | | | |
| 2 | Ignition Detector Set | Disconnect P1, P2, and P3. | | |

Figure 11-6. Function-Testing Ignition Detector (Sheet 1 of 6)

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 3 | Ignition Detector | Check continuity between:<br>a. J2-F to J1-F<br>b. J2-E to J2-G<br>c. J2-E to J2-D<br>d. P3-A to P3-B | Resistance Bridge | a. Less than 0.1 ohm.<br>b. 97.5 to 102.5 ohms.<br>c. 97.5 to 102.5 ohms.<br>d. Less than 0.1 ohm. |
| NOTE: Resistance tester may be left connected to J2-E and J2-D for later test. | | | | |
| 3A | Ignition Detector | Apply 45-50 volts between pin P3-A and receptacle P3 shell. | Meggar | 100 megohms minimum. |
| 4 | Ignition Detector | Connect test equipment. (See figure 11-7.) | | |
| 5 | Ignition Detector | Connect positive lead of voltmeter to positive lead of power supply and negative lead of voltmeter to negative lead of power supply. | | |
| 6 | Decade Box R1 | Increase resistance. | Decade Box R1 | 120 ohms. |
| 7 | Decade Box R2 | Increase resistance. | Decade Box R2 | 120 ohms. |
| 8 | Power Supply | Adjust voltage. | Voltmeter | 23.5 to 24.5 volts. |
| 9 | Test Switch S1 | Move switch to on. | Test Light No. 1 | On. |
| NOTE: If test light No. 2 comes on, perform step 10. If test results are obtained, proceed to step 11. | | | | |
| 10 | Ignition | Remove ignition detector mounting plate and adjust resistor R6 clockwise. | a. Test Light No. 2<br>b. Resistance Bridge | a. Off.<br>b. 97.5 to 102.5 ohms. |

Figure 11-6. Function-Testing Ignition Detector (Sheet 2 of 6)

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 11 | Decade Box R1 | Increase resistance. Results must be simultaneous. Record results b and c. | a. Test Light No. 2<br>b. Decade Box R1<br>c. Resistance Bridge | a. On.<br>b. 129-130 ohms.<br>c. 195-200 ohms. |

NOTE: If test results in step 11 are not obtained simultaneously, adjust resistor R6 clockwise until test light No. 2 goes off, or counterclockwise until results occur. Repeat step 11.

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 12 | Decade Box R1 | Decrease resistance. Record result a. | a. Test Light No. 2<br>b. Resistance Bridge | a. Off and indication on Decade Box greater than 125 ohms.<br>b. 97.5 to 102.5 ohms before Decade Box R1 indicates 125 ohms. |
| 13 | Decade Box R1 | Decrease resistance. | Decade Box R1 | 120 ohms. |

NOTE; Resistance bridge may be disconnected.

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 14 | Power Supply | Adjust voltage. | Voltmeter | 29.5 to 30.5 volts. |
| 15 | Decade Box R1 | Increase resistance. Record result b. | a. Test Light No. 2<br>b. Decade Box R1 | a. On.<br>b. 125-130 ohms. |

NOTE: If the results in step 15 are not obtained, adjust resistor R6 until results are obtained and repeat steps 6 through 15.

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 16 | Decade Box R1 | Decrease resistance. Record result b. | a. Test Light No. 2<br>b. Decade Box R1 | a. Off.<br>b. Greater than 125 ohms. |

Figure 11-6. Function-Testing Ignition Detector (Sheet 3 of 6)

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 17 | Decade Box R1 | Decrease resistance. | Decade Box R1 | 40 ohms. |
| 18 | Decade Box R2 | Decrease resistance. | Decade Box R2 | 40 ohms. |
| 19 | Decade Box R1 | Increase resistance. Record result b. | a. Test light No. 2<br>b. Decade Box R1 | a. On.<br>b. 45-50 ohms. |

NOTE: If results in step 18 are not obtained, adjust resistor R6 until results are obtained and repeat steps 6 through 18.

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 20 | Decade Box R1 | Decrease resistance. Record result b. | a. Test light No. 2<br>b. Decade Box R1 | a. Off<br>b. Greater than 45 ohms. |
| 21 | Decade Box R1 | Decrease resistance. | Decade Box R1 | 40 ohms. |
| 22 | Power Supply | Adjust voltage. | Voltmeter | 23.5 to 24.5 volts |
| 23 | Decade Box R1 | Increase resistance. Record result b. | a. Test light No. 2<br>b. Decade Box R1 | a. On<br>b. 45 to 50 ohms. |

NOTE: If results in step 23 are not obtained, adjust resistor R6 until results are obtained and repeat steps 6 through 23.

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 24 | Decade Box R1 | Decrease resistance. Record result b. | a. Test light No. 2<br>b. Decade Box R1 | a. Off.<br>b. Greater than 45 ohms. |
| 25 | Decade Box R1 | Decrease resistance. | Decade Box R1 | 40 ohms. |

Figure 11-6. Function-Testing Ignition Detector (Sheet 4 of 6)

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 26 | Test Switch No. 2 | Move switch to on. | Test Light No. 2 | On. |
| 27 | Test Switch No. 2 | Move switch to off. | Test Light No. 2 | Off. |
| 28 | Power Supply | Adjust voltage. | Voltmeter | 26.5 to 27.5 volts. |
| 29 | Voltmeter | Disconnect positive lead and connect to pin J1-H on detector set. Record result. | Voltmeter | 8.9 to 10.9 vdc. |

NOTE: Record voltmeter indication for each increment increase in steps 30 and 31. Results must be within tolerances of figure 11-8.

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 30 | Decade Box R1 | Increase resistance in 20-ohm increments to 100 ohms. | a. Test Light No. 2<br>b. Decade Box R1 | a. On.<br>b. 100 ohms. |
| 31 | Decade Box R1 | Increase resistance in 50-ohm increments to 450 ohms. | Decade Box R1 | 450 ohms. |
| 32 | Test Switch No. 1 | Move switch to off. | a. Test Light No. 1<br>b. Test Light No. 2<br>c. Voltmeter | a. Off.<br>b. Off.<br>c. Zero. |
| 33 | Ignition Detector | Disconnect jumper plug and connect test switch No. 3 and calibrated resistor R3 as shown in figure 11-7. | | |
| 34 | Decade Box R1 | Decrease resistance. | Decade Box R1 | 40 ohms. |

Figure 11-6. Function-Testing Ignition Detector (Sheet 5 of 6)

| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 35 | Test Switch No. 1 | Move switch to on. | a. Test Light No. 1<br>b. Voltmeter | a. On.<br>b. 8.9 to 10.9 volts. |
| 36 | Test Switch No. 3 | Move switch to open. Record result. | a. Test Light No. 2<br>b. Voltmeter | a. On.<br>b. 9.0 to 11.0 volts. |
| 37 | Test Switch No. 3 | Move switch to close. | a. Test Light No. 2<br>b. Voltmeter | a. Off.<br>b. 8.9 to 10.9 volts. |
| 38 | Test Switch No. 1 | Move switch to off. | a. Test Light No. 1<br>b. Voltmeter | a. Off.<br>b. Zero. |
| 39 | Power Supply | Adjust voltage to off. | | |
| 40 | Test Equipment | Secure test equipment and ignition detector. | | |
| 41 | Ignition Detector | Install jumper assembly. | | |
| 42 | Ignition Detector | Apply torque striping to resistor R6 adjustment screw. | | |
| 43 | Calibration Chart | Plot recorded data on chart similar to one attached to ignition detector set. Attach to ignition detector set. | | |

Figure 11-6. Function-Testing Ignition Detector (Sheet 6 of 6)

11-12. TESTING TRANSDUCER. To test the transducer, proceed to figure 11-10. If results other than those specified are obtained, terminate the test and replace transducer.

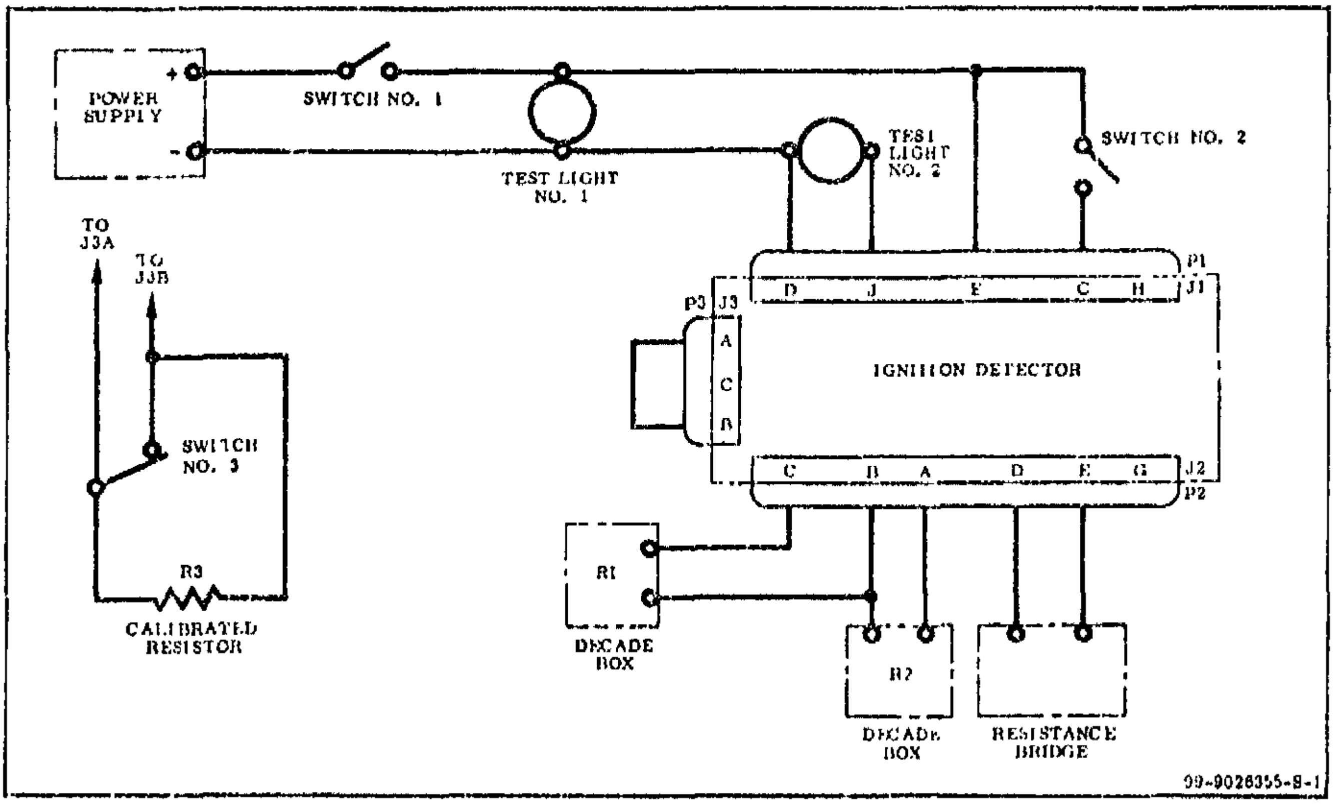



Figure 11-7. Ignition Detector Set Test Schematic

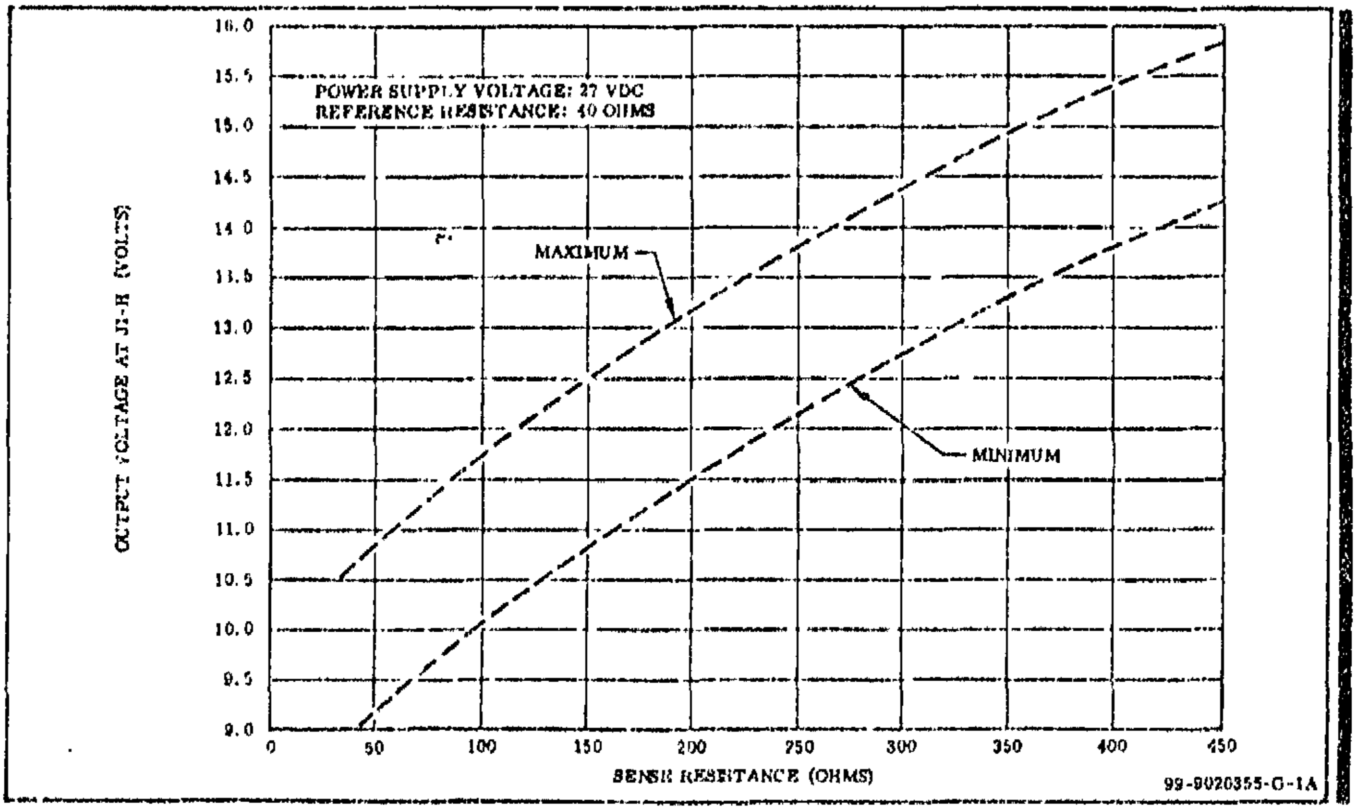



Figure 11-8. Ignition Detector Test Curve

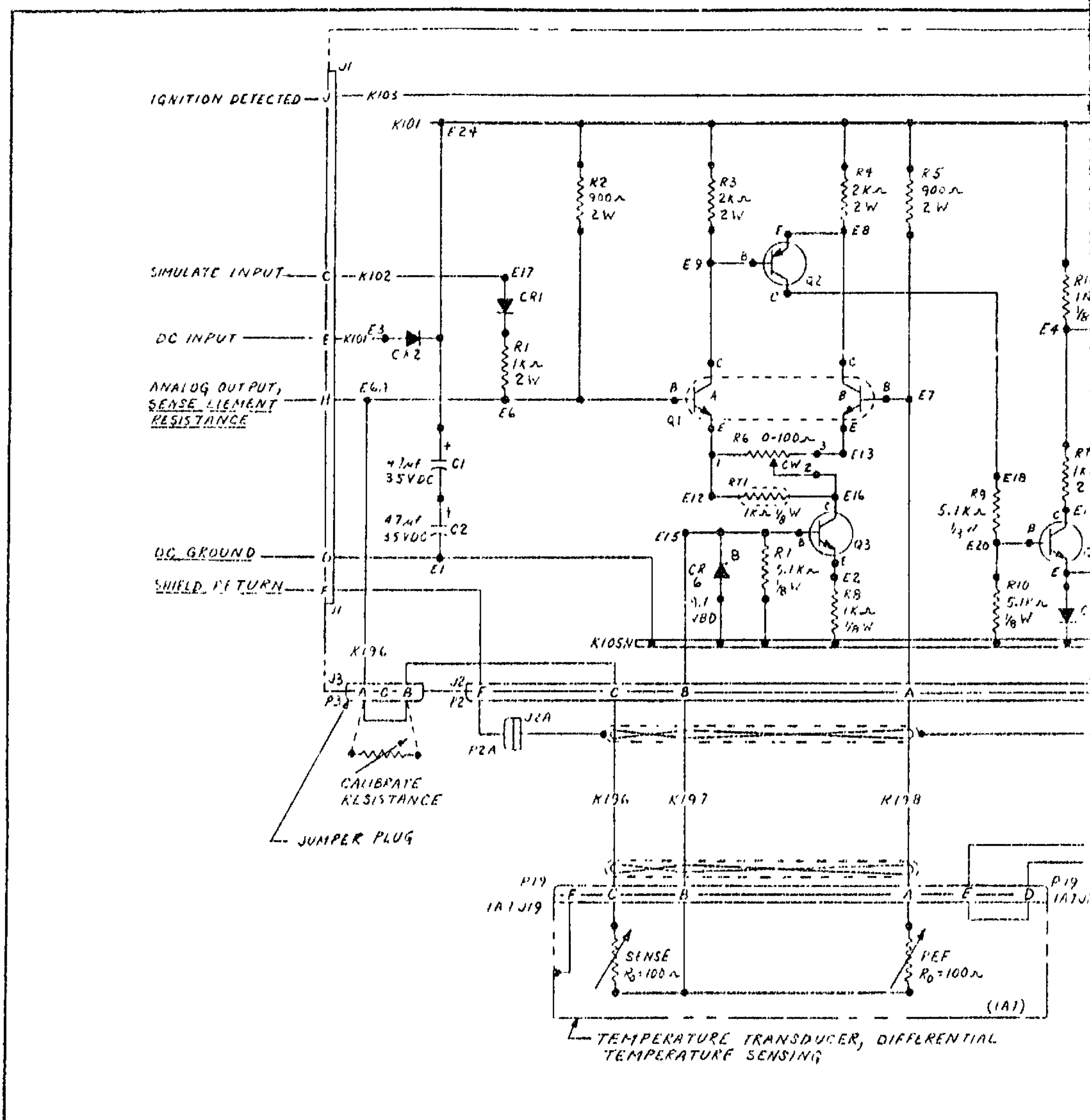
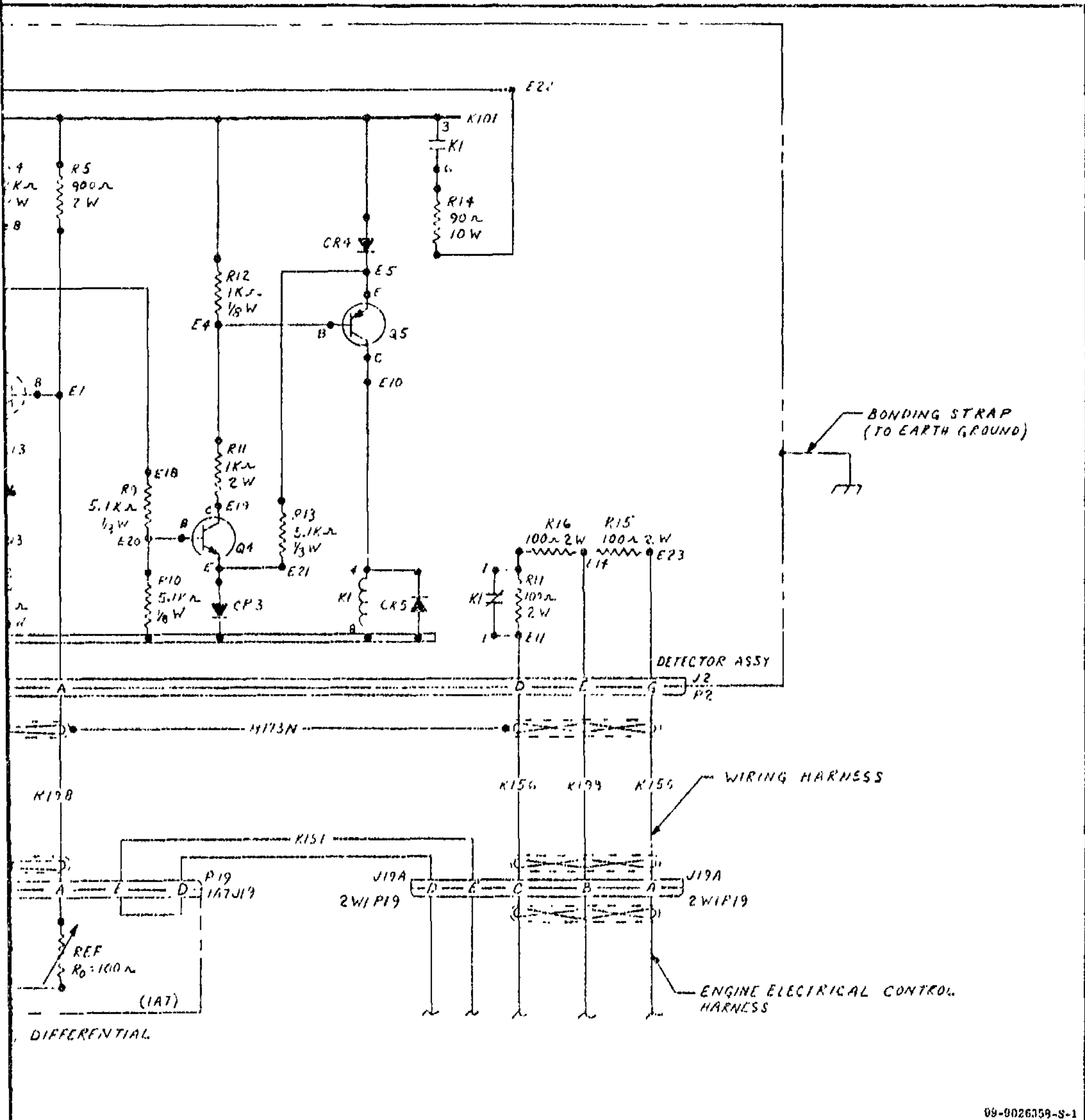



Figure 11-9. Ignition Detector Set Schematic

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| Step | Location | Operation | Location | Result |
|---|---|---|---|---|
| 1 | | Obtain megger and resistance bridge. See figure 11-5. | | |
| 2 | Ignition Detector Set | Disconnect plug P-19. | | |
| 3 | Transducer Receptacle J-19 | Connect negative lead of megger to receptacle shell and positive lead to pins A, B, C, D and E. | | |
| 4 | Megger | Apply 45 to 50 volts. | Megger | Minimum of 100 megohms. |
| 5 | Transducer Receptacle J-19 | Remove positive lead of megger from pins D and E.<br><br>Remove negative lead of megger from shell and connect to pins D and E. | | |
| 6 | Megger | Apply 45 to 50 vdc. | Megger | Minimum of 100 megohms. |
| 7 | Transducer Receptacle | Disconnect megger test leads. | | |
| 8 | Resistance Bridge, Transducer | Measure resistance between:<br>a. Pins D and E<br>b. Pin F and transducer case<br>c. Pins A and B<br>d. Pins B and C | Resistance Bridge | a. Less than 0.1 ohm.<br>b. Less than 0.1 ohm.<br>Difference between substeps c and d shall not exceed 5 ohms. |

Figure 11-10. Testing Transducer

## 11-13. PREPARING IGNITION DETECTOR SET FOR STORAGE OR SHIPMENT.

11-14. Prepare the ignition detector set as follows:

a. Clean ignition detector set. Refer to Cleaning Electrical Components in section I.

b. Install protective covers on electrical receptacles and connectors.

c. Install protective covers on transducer.

## 11-15. MAINTENANCE OF IGNITION DETECTOR SET COMPONENTS.

11-16. Maintenance of components consists of repairing wire harness and plug assembly. No special instructions are required to repair these components. Parts necessary to repair the wire harness or the plug assembly are listed in figure 11-1. See figure 11-11 for the harness wire list.

| Wire Number | From Item and Terminal | To Item and Terminal |
|---|---|---|
| K151A16 | J19A-D | P19-D |
| D151B16 | J19A-E | P19-E |
| K155A16 | P2-G | J19A-A |
| K156A16 | P2-D | J19A-C |
| K196A16 | P2-C | P19-C |
| K197A16 | P2-B | P19-B |
| K198A16 | P2-A | P19-A |
| K199A16 | P2-E | J19-A-B |
| M173A16N | P2-F | P2A-A |
| M173B16N | Shield | |
| | P2-G, P2-E, P2D P2A, P2-B, P2C | J2A-A |

Figure 11-11. Ignition Detector Set Harness Wire List

# SECTION XII

# COMPONENTS MAINTENANCE SETS/KITS

WARNING

THE FOLLOWING GROUND SUPPORT EQUIPMENT MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

9020788, Augmented Spark Igniter Valve Maintenance Set
9020789, Gas Generator Control Valve Maintenance Set
9020791, Start Tank Discharge Valve Maintenance Set
9020793, Tank Support and Fill Valve Maintenance Set
9020794, Helium Regulator Maintenance Set
9020796, Electrical Control and Flight Instrumentation Package Maintenance Kit
9020797, Main Propellant and Oxidizer Turbine Bypass Valves Maintenance Set
9022337, Valves Buildup Fixture Kit
9024725, Purge Control and Fast Shutdown Valve Maintenance Kit

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(continued)

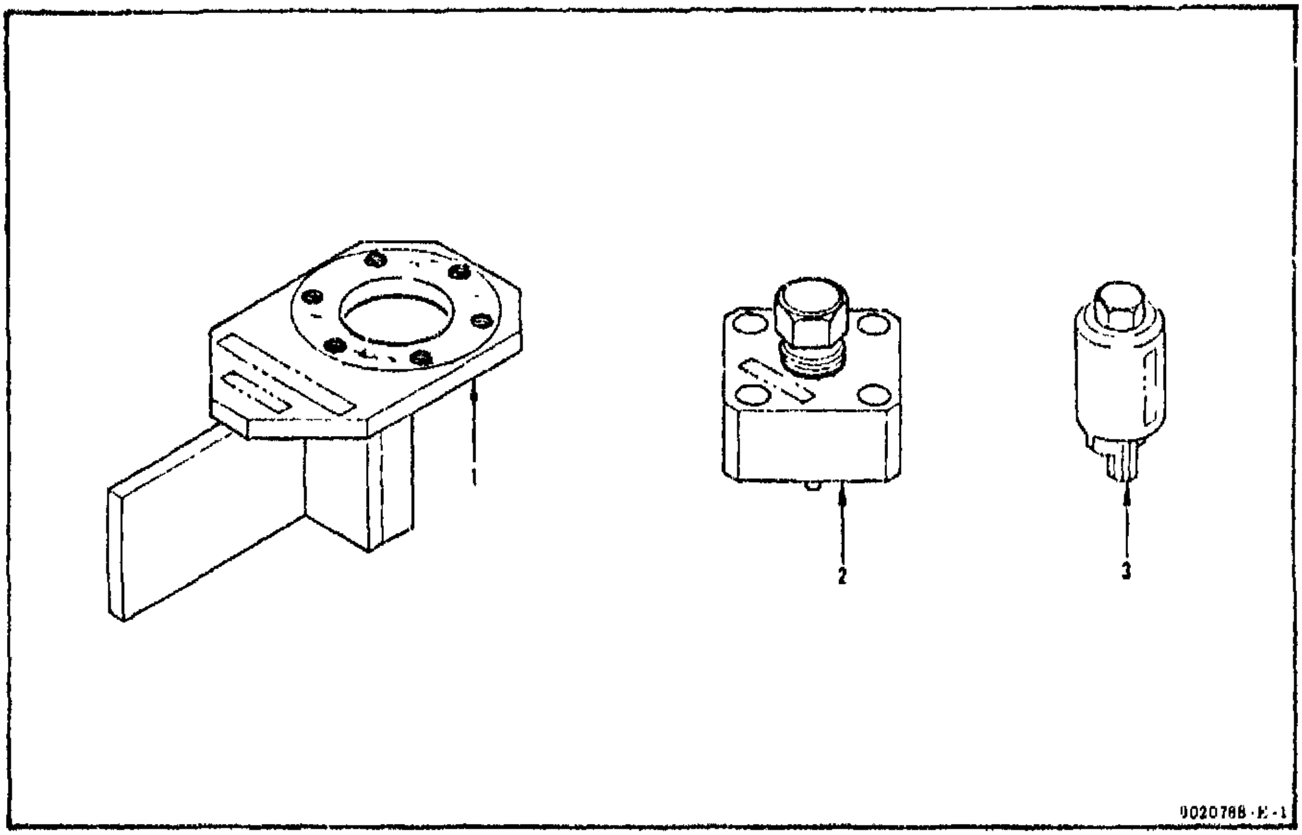


## 12-1. DESCRIPTION OF COMPONENTS MAINTENANCE SETS/KITS.

12-2. The components maintenance sets and kits consist of special tools used to perform assembly, disassembly, or repair of engine components. The maintenance sets are comprised of maintenance kits used to repair a component. The maintenance kits contain the special tools to perform a task or repair a component. The descriptions and maintenance requirements for each set and kit are presented in this section. Information relative to the use of maintenance sets/kits is in Technical Manual R-3825-3.

## 12-3. DESCRIPTION OF AUGMENTED SPARK IGNITER VALVE MAINTENANCE SET 9020788.

12-4. The maintenance set (figure 12-1) is used to assemble and disassemble the augmented spark igniter valve. The set contains a kit with a fixture, a lifter housing, and a wrench. The fixture supports the valve or valve housing during




| Index Number | Part Number | Nomenclature | Source and Recoverability Code (Refer to section I.) |
|---|---|---|---|
| | 9020788 | Augmented Spark Igniter Valve Maintenance Set | F-1 |
| | 9024889 | Augmented Spark Igniter Valve Fixture Kit | F-1 |
| | VD192-0002-1286 | Container | F-3 |
| 1 | 9025381 | Fixture | F-1 |
| 2 | 9025382 | Lifter Housing | F-1 |
| | 9025383 | Lifter | F-3 |
| | 9025386 | Housing | F-1 |
| 3 | 9025393 | Wrench | F-3 |
| | AN101119 | Bolt | F-3 |
| | LD153-0011-0014 | Washer | F-3 |
| | NAS509-4 | Nut | F-3 |

Figure 12-1. Augmented Spark Igniter Valve Maintenance Set

maintenance. The fixture has a mounting surface with holes to allow mounting of the valve or valve housing. A protective surface is provided to protect the valve. The lifter housing compresses the valve bellows allowing the installation and removal of the poppet. The lifter housing consists of a lifter which threads into the housing. The lifter contains bearings and a poppet adapter. The housing has a protective surface and matching mounting holes. The wrench used to torque the valve poppet has a tip to fit the poppet and adapter to standard tools. The tools are packed in a reusable container.

12-5. MAINTENANCE OF AUGMENTED SPARK IGNITER VALVE MAINTENANCE SET.

12-6. Maintenance tasks required on the set are listed in figure 12-2. Information presented lists the tasks to be performed, when the tasks are to be performed, and where data support for the tasks may be found. See figure 12-1 for parts identification when replacing parts. The only maintenance instructions required are to c ment the etched side of the protective surface, etched one side Teflon sheet RB0130-008 (Rocketdyne), to the fixture with EC-776 cement (Minnesota Mining and Mfg), or equivalent. The protective surface shall clear the holes in the fixture. Replace protective surface on lifter housing with plastic film tape 549GCS (Minnesota Mining and Mfg), or equivalent.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect set for completeness | X | X | | | See figure 12-1. |
| Inspect tools for nicks, scratches and burs on critical surfaces | X | X | | | Replace damaged part or tool. See figure 12-1. |
| Inspect fixture and lifter housing for damaged protective surfaces | X | X | | | Replace protective surface. See figure 12-1. Refer to paragraph 12-5. |
| Inspect lifter bearings for restricted movement | X | X | | | Replace lifter. |

Figure 12-2. Maintenance Requirements for Augmented Spark Igniter Valve Maintenance Set (Sheet 1 of 2)

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect for galling indicating dry film lubricant worn from lifter threads | X | X | | | Replace lifter. |
| Clean tools | | X | | | Refer to Cleaning in Volume I, section I. |
| Prepare set for storage | | | X | | Refer to paragraph 12-7. |

Figure 12-2. Maintenance Requirements for Augmented Spark Igniter Valve Maintenance Set (Sheet 2 of 2)

12-7. STORING AU[illegible]ENTED SPARK IGNITER VALVE MAINTENANCE SET.

12-8. Prepare maintenance set for storage as follows:

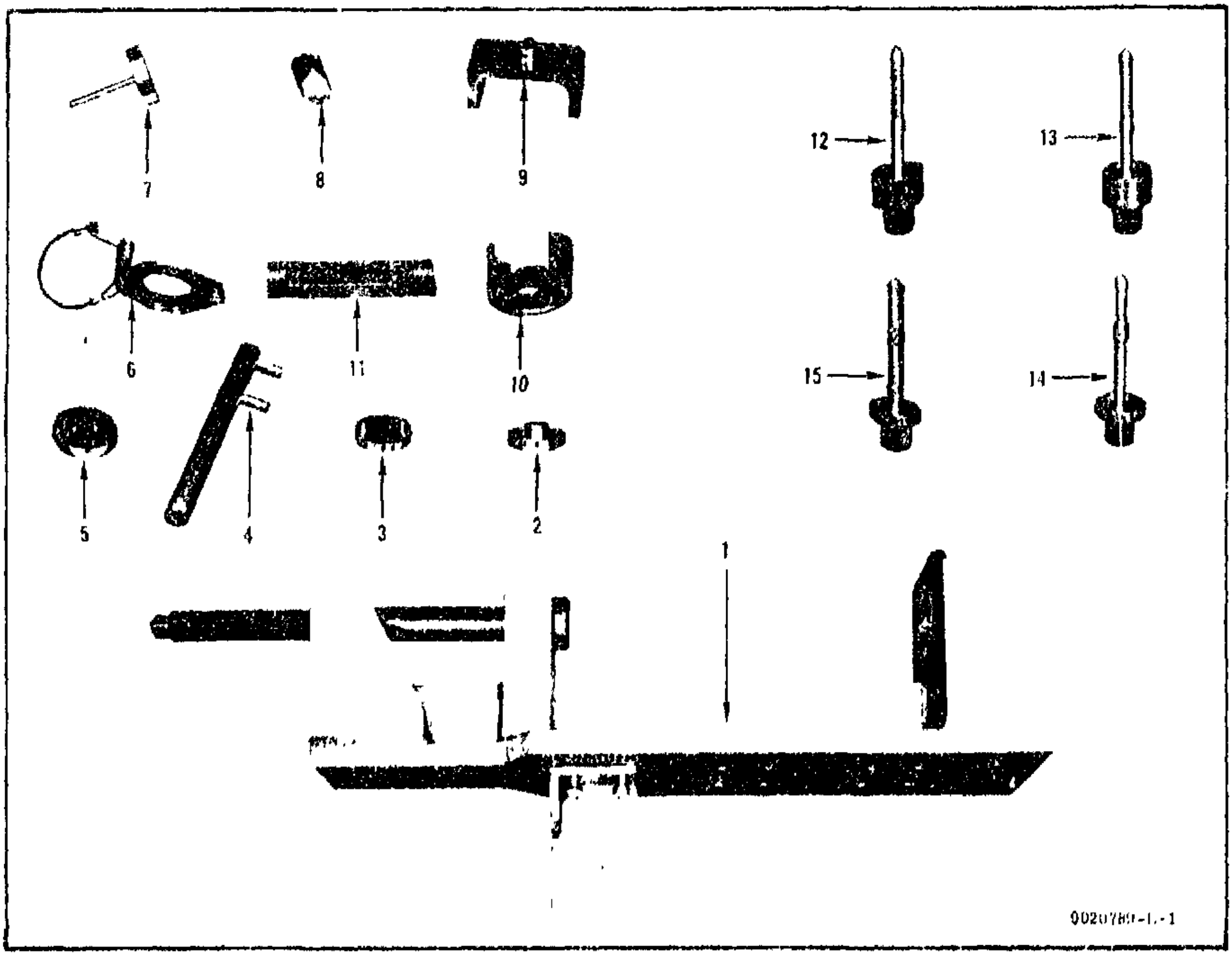
a. Clean tools. Refer to Cleaning in Volume I, section I.

b. Place tools in container and ensure tools do not contact each other. Refer to figure 12-1 for container.

c. Secure container and store maintenance kit.

12-9. DESCRIPTION OF GAS GENERATOR CONTROL VALVE MAINTENANCE SET 9020789.

12-10. The maintenance set (figure 12-3) is used to assemble, disassemble, and perform maintenance on the gas generator control valve. The maintenance set consists of a fixture kit, an adapter kit, and a lapping tool kit. The compressor fixture, from the fixture kit, is used to support the valve and compress the valve




| Index Number | Part Number | Nomenclature | Source and Recoverability Code (Refer to section I.) |
|---|---|---|---|
| | 9020789 | Gas Generator Control Valve Maintenance Set | F-1 |
| | 9024819 | Fixture Kit | F-1 |
| | NH1-177-9 | Container | F-3 |
| 1 | 9024820 | Compressor Fixture | F-1 |
| | 9024821 | Fixture Base | F-1 |
| | 9024822 | Shaft | F-3 |
| | 9024823 | Bracket | F-3 |
| | AN5-14A | Bolt | F-3 |
| | LD153-0010-0012 | Washer | F-3 |
| | 9024824 | Adapter Kit | F-1 |
| | VD192-0008-0015 | Container | F-3 |

Figure 12-3. Gas Generator Control Valve Maintenance Set (Sheet 1 of 2)

| Index Number | Part Number | Nomenclature | Source and Recoverability Code (Refer to section I.) |
|---|---|---|---|
| 2 | 9024825 | Force Gage Adapter | F-3 |
| 3 | 9024826 | Retainer Wrench | F-3 |
| 4 | 9024827 | Spring Retainer Adapter | F-3 |
| 5 | 9024828 | Bellows Retainer Adapter | F-3 |
| 6 | 9024829 | Spring Retainer Clamp | F-3 |
| | 9024830 | Upper Clamp | F-3 |
| | 9024831 | Lower Clamp | F-3 |
| | NAS1297-3-3 | Bolt | F-3 |
| | NAS679C3W | Nut | F-3 |
| | NAS1334C5C04F | Pin | F-3 |
| | MS171598 | Pin | F-3 |
| | RD191-2002-1206 | Cable | F-3 |
| | 28-C-1 | Sleeve | F-3 |
| 7 | 9024832 | Actuator Compression Adapter | F-3 |
| 8 | 9024833 | Poppet Torquing Adapter | F-3 |
| 9 | 9024834 | Fuel Bellows Nut Wrench | F-3 |
| 10 | 9024835 | Spring Compression Adapter | F-3 |
| 11 | 9024836 | Yoke Compression Adapter | F-3 |
| | LD153-0010-0019 | Washer | F-3 |
| | LD153-0010-0013 | Washer | F-3 |
| | MS20004H12 | Bolt | F-3 |
| | MS20006H12 | Bolt | F-3 |
| | NAS509-4 | Nut | F-3 |
| | NAS509-6 | Nut | F-3 |
| | 9024837 | Lapping Tool Kit | F-1 |
| | VD192-0002-1286 | Container | F-3 |
| 12 | 9024838 | Oxidizer Valve Seat Lapping Tool | F-2 |
| 13 | 9024839 | Oxidizer Valve Relief Lapping Tool | F-2 |
| 14 | 9024840 | Fuel Valve Relief Lapping Tool | F-2 |
| 15 | 9024841 | Fuel Valve Seat Lapping Tool | F-2 |

Figure 12-3. Gas Generator Control Valve Maintenance Set (Sheet 2 of 2)

bellows and springs. The compressor fixture incorporates a threaded shaft in a base valve mounting holes, and a protective surface for the valve. A thrust bearing has been incorporated at one end of the shaft. A bracket used to mount the compressor fixture in a vise and may be mounted in one of three positions on the compressor fixture, and attaching hardware are included in the kit. The

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect maintenance set for completeness | X | X | | | See figure 12-3. |
| Inspect tools for nicks, burs, and scratches | X | X | | | Replace damaged part or tool as required. See figure 12-3. |
| Inspect fixture for damaged protective surfaces | X | X | | | Replace protective surface. Refer to paragraph 12-11. |
| Inspect lapping tool surfaces for concentric rings and flatness indicating wear | X | X | | | Replace lapping tool. |
| Inspect fixture shaft bearing for restricted movement | X | X | | | Replace shaft. See figure 12-3. |
| Inspect fixture shaft threads for galling indicating absence of dry film lubricant | X | X | | | Replace shaft. See figure 12-3. |
| Clean tools | | X | | | Refer to Cleaning in Volume I, section I. |
| Prepare maintenance set for storage | | | X | | Refer to paragraph 12-13. |

Figure 12-4. Maintenance Requirements for Gas Generator Control Valve Maintenance Set

adapter kit contains tools used in conjunction with the compressor fixture and torquing adapters. The torquing adapters fit valve components and have provisions to adapt to standard tools. The lapping tool kit contains tools for lapping the valve seats. Each of the lapping tools incorporates a guide shaft, lapping surface, and a knurled handle. A reusable tool container is provided for each kit.

12-11. MAINTENANCE OF GAS GENERATOR CONTROL VALVE MAINTENANCE SET.

WARNING

The following specifies adhesive EC776, which is flammable and must not be used near heat, sparks, or open flame. It is toxic. Inhalation of its vapors or prolonged contact with the adhesive can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

12-12. Maintenance tasks required on the maintenance set are listed in figure 12-4. The information presented lists the tasks to be performed, when the tasks are to be performed, and where the data support for the tasks will be found. When replacing parts or tools, see figure 12-3 for identification. The only maintenance instructions required are for cementing the etched side of the protective surface, etched one side teflon sheet RB0130-008 (Rocketdyne), to the fixture with EC-776 cement (Minnesota Mining and Mfg), or equivalent. When assembling bracket to fixture, torque bolts to 48-55 inch-pounds.

12-13. STORING GAS GENERATOR CONTROL VALVE MAINTENANCE SET.

12-14. Prepare the maintenance set for storage as follows:

a. Clean tools. Refer to Cleaning in Volume I, section I.

b. Place tools in correct container and make sure tools do not touch each other. (See figure 12-3 for correct container.)

NOTE

Protective packaging may be removed from tool to fit tool into container.

CAUTION

Tools contacting each other candamage finished surfaces of tools.

c. Secure container and store maintenance kits.

## 12-15. DESCRIPTION OF START TANK DISCHARGE VALVE MAINTENANCE SET 9020791.

12-16. The maintenance set (figure 12-5) is used to assemble, disassemble, and perform maintenance on the start tank discharge valve. The maintenance set consists of a lapping tool kit and a maintenance tool kit. The lapping tool kit contains tools for lapping the valve inlet seat relief, outlet seat relief, and the inlet, outlet, and outlet gate seats. The tools incorporate a knurled handle and lapping surface with guides on the two relief lapping tools. The maintenance tool kit contains a spring compressor, shaft installing spring compressor, torquing adapters, and a protector. The spring compressors are used to compress valve springs and provide seat-to-seal clearance. The spring compressor has a swivel screw clamp threaded through a plate and two posts which attach to the plate and valve. The shaft installing spring compressor is a disk with a protective ring and protective washer on the surfaces contacting the valve. The torquing adapters fit the bellows seal and retainer of the valve and have provisions to adapt to standard tools. The protector is a shaft with a tapered end to guide the valve shaft through the lipseals into the housing. A reusable container is provided for each kit.

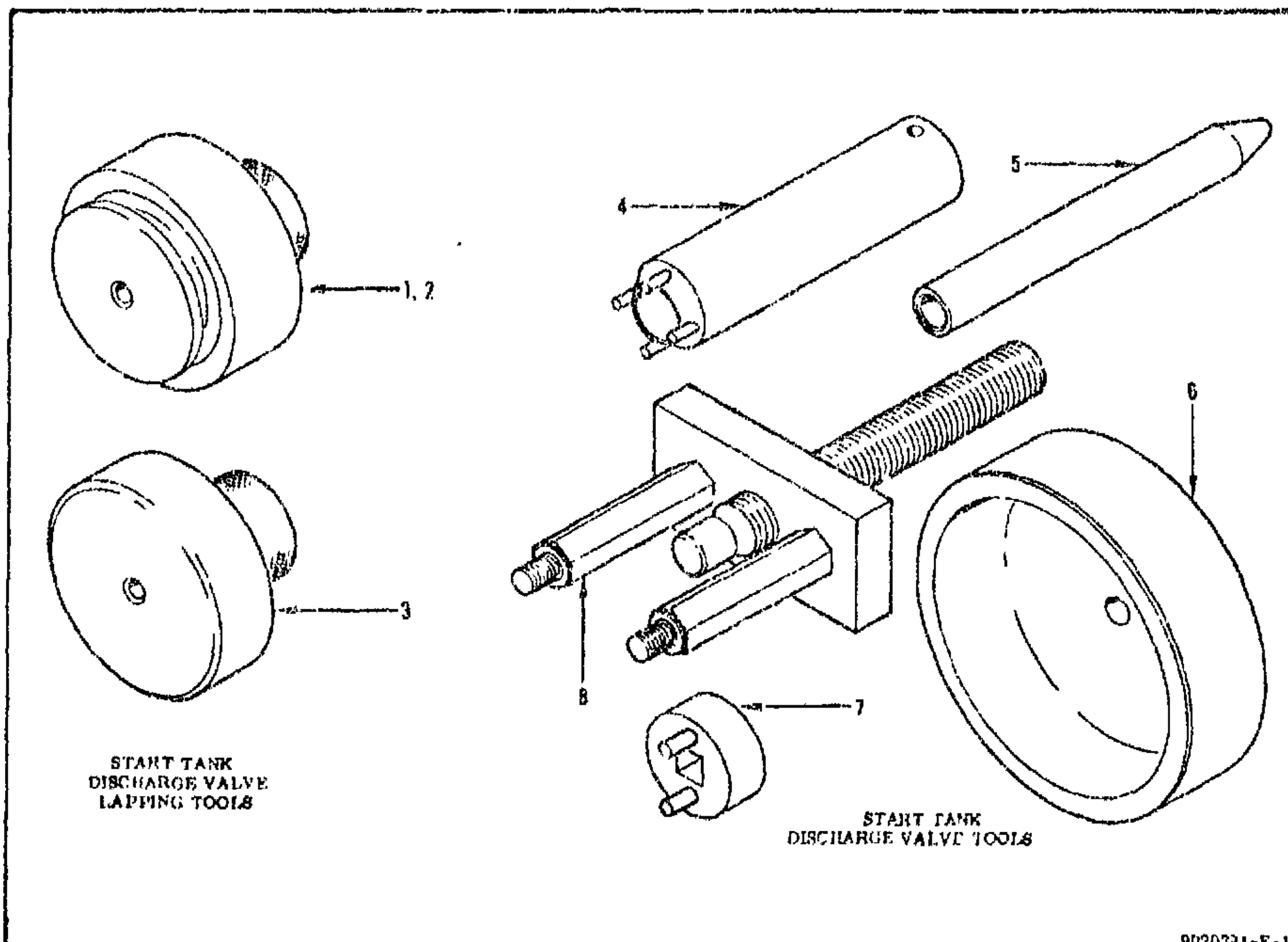



Figure 12-5. Start Tank Discharge Valve Maintenance Set (Sheet 1 of 2)

| Index Number | Part Number | Nomenclature | Source and Recoverability Code (Refer to section I.) |
|---|---|---|---|
| | 9020791 | Start Tank Discharge Valve Maintenance Set | F-1 |
| | 9024852 | Lapping Tool Kit | F-1 |
| | VD192-0002-1644 | Container | F-3 |
| 1 | 9024854 | Inlet Seat Relief Lapping Tool | F-2 |
| 2 | 9024855 | Outlet Seat Relief Lapping Tool | F-2 |
| 3 | 9024856 | Inlet, Outlet, and Gate Seats Lapping Tool | F-2 |
| | 9024853 | Start Tank Discharge Valve Tool Kit | F-1 |
| | VD192-0008-0015 | Container | F-3 |
| 4 | 9024860 | Retainer Torquing Adapter | F-3 |
| 5 | 9024861 | Shaft Threads Protector | F-3 |
| 6 | 9024862 | Shaft Installing Spring Compressor | F-1 |
| 7 | 9024863 | Bellows Torquing Adapter | F-3 |
| 8 | 9024867 | Spring Compressor | F-1 |
| | 9024857 | Spring Compressor Plate | F-3 |
| | 9024858 | Spring Compressor Post | F-3 |
| | CL-42-SSC-CAD | Swivel Screw Clamp | F-3 |
| | LD153-0010-0010 | Washer | F-3 |
| | MS20500-428 | Nut | F-3 |

Figure 12-5. Start Tank Discharge Valve Maintenance Set (Sheet 2 of 2)

12-17. MAINTENANCE OF START TANK DISCHARGE VALVE MAINTENANCE SET.

WARNING

The following specifies adhesive EC776, which is flammable and must not be used near heat, sparks, or open flame. It is toxic. Inhalation of its vapors or prolonged contact with the adhesive can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

12-18. Maintenance tasks required on the maintenance set are listed in figure 12-6. The information presented lists the tasks to be performed, when the tasks are to be performed, and where the data support tasks will be found. When replacing tools or parts, see figure 12-5 for identification. Maintenance instructions consist of requirements for torquing and replacing protective surfaces. Torque spring compressor nuts to 14-17 inch-pounds. Cement the etched side of the protective ring and washer, etched one side teflon sheet RB0130-008 (Rocketdyne), on the shaft installing spring compressor with EC-776 (Minnesota Mining and Mfg), or equivalent.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect maintenance set for completeness | X | X | | | See figure 12-5. |
| Inspect tools for nicks, scratches and burs on critical surfaces | X | X | | | Replace damaged tool. See figure 12-5. |
| Clean tools | | X | | | Refer to Cleaning in Volume I, section I. |
| Inspect lapping tool lapping surfaces for concentric rings and flatness indicating wear | X | X | | | Replace lapping tool. |
| Inspect protective ring and washer for damaged protective surfaces | X | X | | | Replace protective surface. Refer to paragraph 12-17. |
| Inspect threads of spring compressor for galling threads | X | X | | | Replace damaged part. See figure 12-5. |
| Prepare maintenance set for storage | | | X | | Refer to paragraph 12-19. |

Figure 12-6. Maintenance Requirements for Start Tank Discharge Valve Maintenance Set

12-19. STORING START TANK DISCHARGE VALVE MAINTENANCE SET.

12-20. Prepare the maintenance set for storage as follows:

a. Clean maintenance set tools. Refer to Cleaning in Volume I, section I.

b. Place tools in proper container and ensure tools do not contact each other. Refer to figure 12-5 for proper container.

CAUTION

Tools contacting each other can damage finished surfaces of tools.

c. Secure container and store maintenance kits.

12-21. DESCRIPTION OF TANK SUPPORT AND FILL VALVE MAINTENANCE KIT 9020793.

12-22. The maintenance kit (figure 12-7) is used to repair the tank support and fill valve. The maintenance kit consists of a lapping tool and a torquing adapter. The lapping tool is used to lap the valve poppet sealing surface. The cylindrical tool has a different size internal lapping surface at each end. A knurled surface on both ends aids in the use of the tool. The torquing adapter is used to torque the retaining nut into the valve. The torquing adapter is a circular tool with 2 pins protruding from both flat surfaces to fit the retaining nuts and receptacle to adapt to standard tools. The tools are packaged in a reusable container.

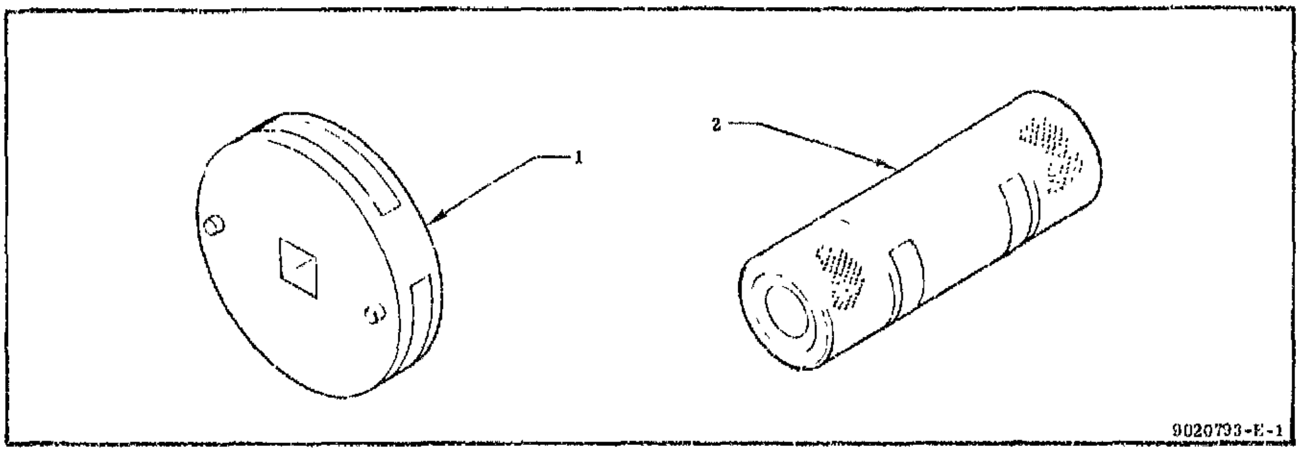
12-23. MAINTENANCE OF TANK SUPPORT AND FILL VALVE MAINTENANCE KIT.

12-24. Maintenance tasks required on the maintenance kit are listed in figure 12-8. The information presented lists the tasks to be performed, when the tasks are to be performed and where the data support for the tasks will be found. When replacing tools, see figure 12-7 for identification. No special instructions are necessary for maintenance tasks.

12-25. STORING TANK SUPPORT AND FILL VALVE MAINTENANCE KIT.

12-26. Prepare the maintenance kit for storage as follows:

a. Clean maintenance kit tools. Refer to Cleaning in Volume I, section I.




| Index Number | Part Number | Nomenclature | Source and Recoverability Code (Refer to section I.) |
|---|---|---|---|
| | 9020793 | Tank Support and Fill Valve Maintenance Kit | F-1 |
| | VD192-0002-0844 | Container | F-3 |
| 1 | 9024865 | Torquing Adapter | F-3 |
| 2 | 9024866 | Poppets Lapping Tool | F-3 |

Figure 12-7. Tank Support and Fill Valve Maintenance Kit

b. Place tools in proper container and ensure tools do not contact each other. Refer to figure 12-7 for proper container.

CAUTION

Tools contacting each other can damage finished surfaces of tools.

c. Secure container and store maintenance kit.

## 12-27. DESCRIPTION OF HELIUM REGULATOR MAINTENANCE KIT 9020794.

12-28. The maintenance set (figure 12-9) is used to disassemble, repair, and assemble the helium regulator. The maintenance set contains torquing adapters and a lapping tool. The torquing adapters are used to torque the low-pressure relief jamnut, bleed regulator inlet seat retainer, and the actuator screw. The

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect maintenance kit for completeness | X | X | | | See figure 12-7. |
| Inspect tools for nicks, scratches, and burs | X | X | | | Replace damaged tools. See figure 12-7. |
| Inspect lapping tool lapping surface for concentric ring and flatness indicating wear | X | X | | | Replace lapping tool. See figure 12-7. |
| Clean tools | | X | | | Refer to Cleaning in Volume I, section I. |
| Prepare maintenance kit for storage | | | X | | Refer to paragraph 12-25. |

Figure 12-8. Maintenance Requirements for Tank Support and Fill Valve Maintenance Kit

adapters are made from hexagonal stock to adapt to standard tools and are machined to fit the regulator components. The lapping tool is used to lap the regulator sealing boss. The cylindrical tool has a guide and a lapping surface and is knurled at one end. The tools are packaged in a reusable container.

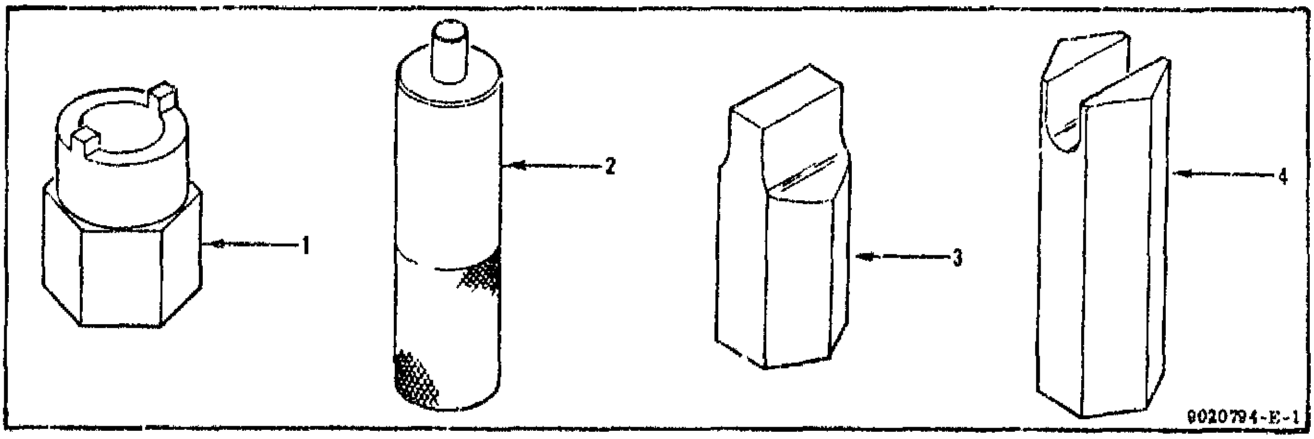



Figure 12-9. Helium Regulator Maintenance Kit (Sheet 1 of 2)

| Index Number | Part Number | Nomenclature | Source and Recoverability Code (Refer to section I.) |
|---|---|---|---|
| | 9020794 | Helium Regulator Maintenance Kit | F-1 |
| | VD192-0002-0844 | Container | F-3 |
| 1 | 9024801 | Low Pressure Relief Valve Torquing Adapter | F-3 |
| 2 | 9024802 | Bleed Regulator Sealing Boss Lapping Tool | F-3 |
| 3 | 9024803 | Bleed Regulator Inlet Seat Retainer Torquing Adapter | F-3 |
| 4 | 9024804 | Actuator Screw Torquing Adapter | F-3 |

Figure 12-9. Helium Regulator Maintenance Kit (Sheet 2 of 2)

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect maintenance kit for completeness | X | X | | | See figure 12-9. |
| Inspect tools for nicks, scratches and burs | X | X | | | Replace damaged tools. See figure 12-9. |
| Inspect lapping tool lapping surface for concentric rings and flatness indicating wear | X | X | | | Replace lapping tool. See figure 12-9. |
| Clean torquing adapters | | X | | | Refer to Cleaning in Volume I, section I. |
| Clean lapping tool | | X | | | Refer to Cleaning in Volume I, section I. |
| Prepare maintenance kit for storage | | | X | | Refer to paragraph 12-31. |

Figure 12-10. Maintenance Requirements for Helium Regulator Maintenance Kit

## 12-29. MAINTENANCE OF HELIUM REGULATOR MAINTENANCE KIT.

12-30. Maintenance tasks required on the maintenance kit are listed in figure 12-10. The information presented lists the tasks to be performed, when the tasks are to be performed, and where the data support for the tasks will be found. When replacing tools, see figure 12-9 for identification. No special instructions are necessary for maintenance tasks.

## 12-31. STORING HELIUM REGULATOR MAINTENANCE KIT.

12-32. Prepare the maintenance kit for storage as follows:

a. **Clean maintenance kit tools. Refer to Cleaning in Volume I, section I.**

b. Place tools in proper container and ensure tools do not contact each other. Refer to figure 12-9 for proper container.

CAUTION

Tools contacting each other can damage finished surfaces of tools.

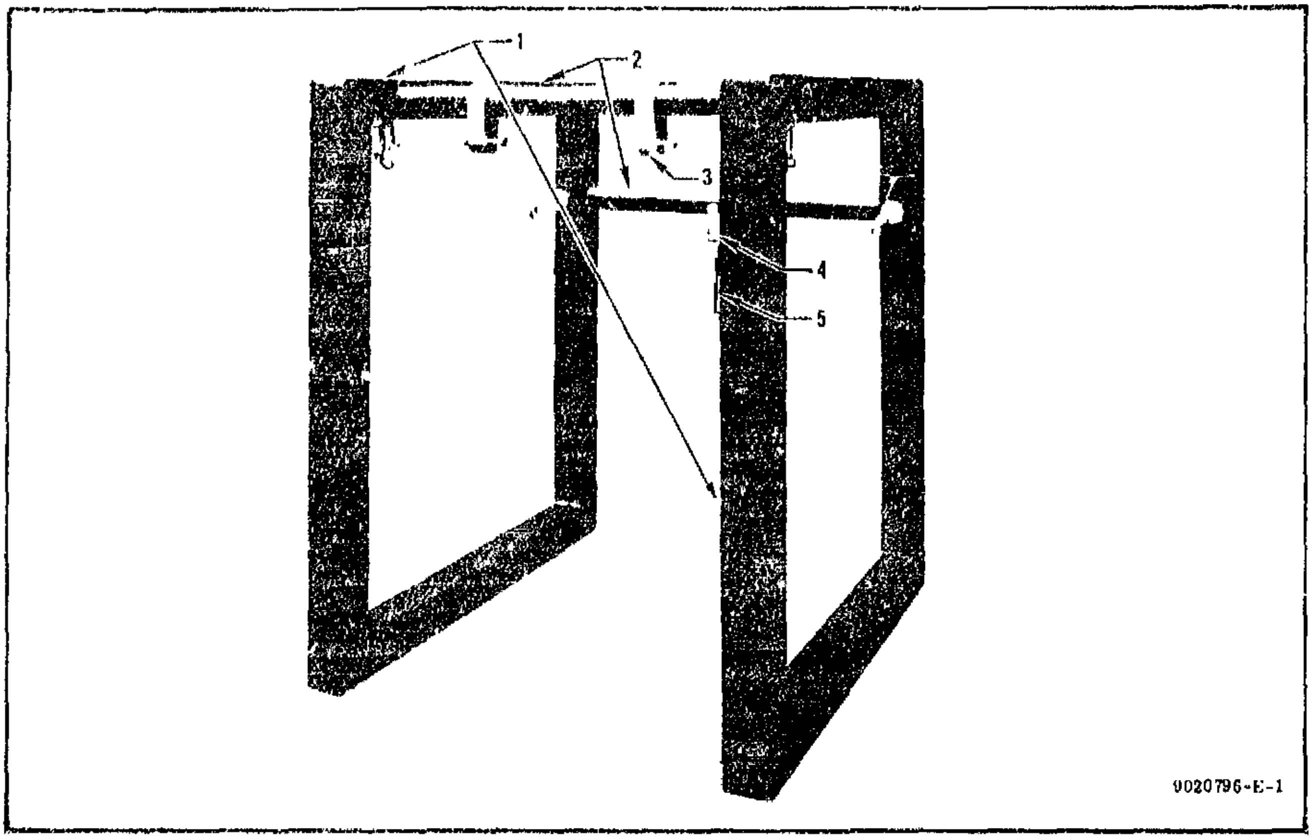
c. Secure container and store maintenance kits.

## 12-33. DESCRIPTION OF ELECTRICAL CONTROL AND FLIGHT INSTRUMENTATION PACKAGE MAINTENANCE KIT 9020796.

12-34. The maintenance kit contains a support frame used to support the primary and secondary flight instrumentation packages and the electrical control package. Figure 12-11 shows the support frame assembled. The support frame is disassembled when packaged in the reusable kit container. The support frame is assembled from two rectangular frames, two rod supports, and quick-release ball lockpins. A clamp and adapter are installed on the supports and can be adjusted to hold any one of the electrical packages.

## 12-35. MAINTENANCE OF ELECTRICAL CONTROL AND FLIGHT INSTRUMENTATION PACKAGE MAINTENANCE KIT.

12-36. Maintenance tasks required on the maintenance kit are listed in figure 12-12. The information presented lists the tasks to be performed, when the tasks are to be performed, and where the data support for the tasks will be found. When replacing parts, see figure 12-11 for identification. No special instructions are necessary for maintenance tasks.




| Index Number | Part Number | Nomenclature | Source and Recoverability Code (Refer to section I.) |
|---|---|---|---|
| | 9020796 | Electrical Control and Flight Instrumentation Package Maintenance Kit | F-1 |
| | NH1-177-5 | Container | F-3 |
| | 9024816 | Support Frame | F-1 |
| 1 | 9024811 | Frame | F-1 |
| | NAS1336C3C07D | Pin | F-3 |
| | RD191-2002-1108 | Cable | F-3 |
| | 28-1C | Sleeve | F-3 |
| 2 | 9024812 | Support | F-3 |
| 3 | 9024813 | Clamp | F-3 |
| | NAS1351-4-14P | Screw | F-3 |
| 4 | 9024814 | Clamp | F-3 |
| 5 | 9024815 | Adapter | F-3 |
| | AN316C6 | Nut | F-3 |
| | LD153-0010-0013 | Washer | F-3 |
| | NAS1351-4-14P | Screw | F-3 |

Figure 12-11. Electrical Control and Flight Instrumentation Package Maintenance Kit

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect maintenance kit for completeness | X | X | | | See figure 12-11. |
| Inspect ball lockpins for operation | X | X | | | Replace inoperative pins. See figure 12-11. |
| Inspect for frayed or broken cables | X | X | | | Replace cables. See figure 12-11. |
| Inspect frames for cracked welds | X | X | | | Replace damaged part. See figure 12-11. |
| Inspect tools for damaged threads | X | X | | | Replace damaged tool. See figure 12-11. |
| Clean support frame | | | X | | Refer to Cleaning in Volume I, section I. |
| Prepare maintenance set for storage | | | X | | Refer to paragraph 12-37. |

Figure 12-12. Maintenance Requirements for Electrical Control and Flight Instrumentation Package Maintenance Kit

12-37. STORING ELECTRICAL CONTROL AND FLIGHT INSTRUMENTATION PACKAGE MAINTENANCE KIT.

12-38. Prepare maintenance set for storage as follows:

a. Disassemble support frame.

b. Clean support frame. Refer to Cleaning in Volume I, section I.

c. Place support frame in container. Ensure parts do not contact each other.

d. Secure container and store maintenance kit.

## 12-39. DESCRIPTION OF MAIN PROPELLANT AND OXIDIZER TURBINE BYPASS VALVES MAINTENANCE SET 9020797.

12-40. The maintenance set (figure 12-13) is used to assemble, disassemble, and repair the main oxidizer, main fuel, and oxidizer turbine bypass valves. The maintenance set is comprised of a compressor kit, seal compression tool kit, an adapter tool kit, and ten seal forming and installation kits. The compressor kit contains a compressor tool used to compress valve actuator springs. The compressor tool has a shaft threaded through a bracket and bushing. A bearing, adapter, and handle complete the shaft. Three compressor rods which attach to a support, complete the compressor tool. The compressor tool is partially assembled in the kit. Installing the support on the valve to be reworked and attaching the compressor rods to the bracket complete the tool. The seal compression tool kit contains a compressor and an interchangeable disk. The tool is used to impress valve retainer serrations into the gate seal. The seal compression tool has a shaft threaded through a frame containing a threaded insert. The shaft assembly contains a swivel, spring, bearing, pin, and disk. Either disk may be installed on the shaft assembly. Two adapters with protective surfaces are attached to the frame. The adapter tool kit contains torque wrench adapters used to torque the propellant valve sequence rod and clevis nut. The adapters fit the valve components and adapt to a standard tool. The kit also contains a simulator shaft, a stepped shaft used to support the valve gate during seal installation, and a holding bar and two holding bar screws. The forming and installing tool kits contain various piloting tools, guides, noses, plugs, sleeves, and seal forming tools used to form and install seals on various valve components. The main propellant valves lipseal forming and installing kit contains two matched sets of tools. A reusable container is provided for the tools of each kit.

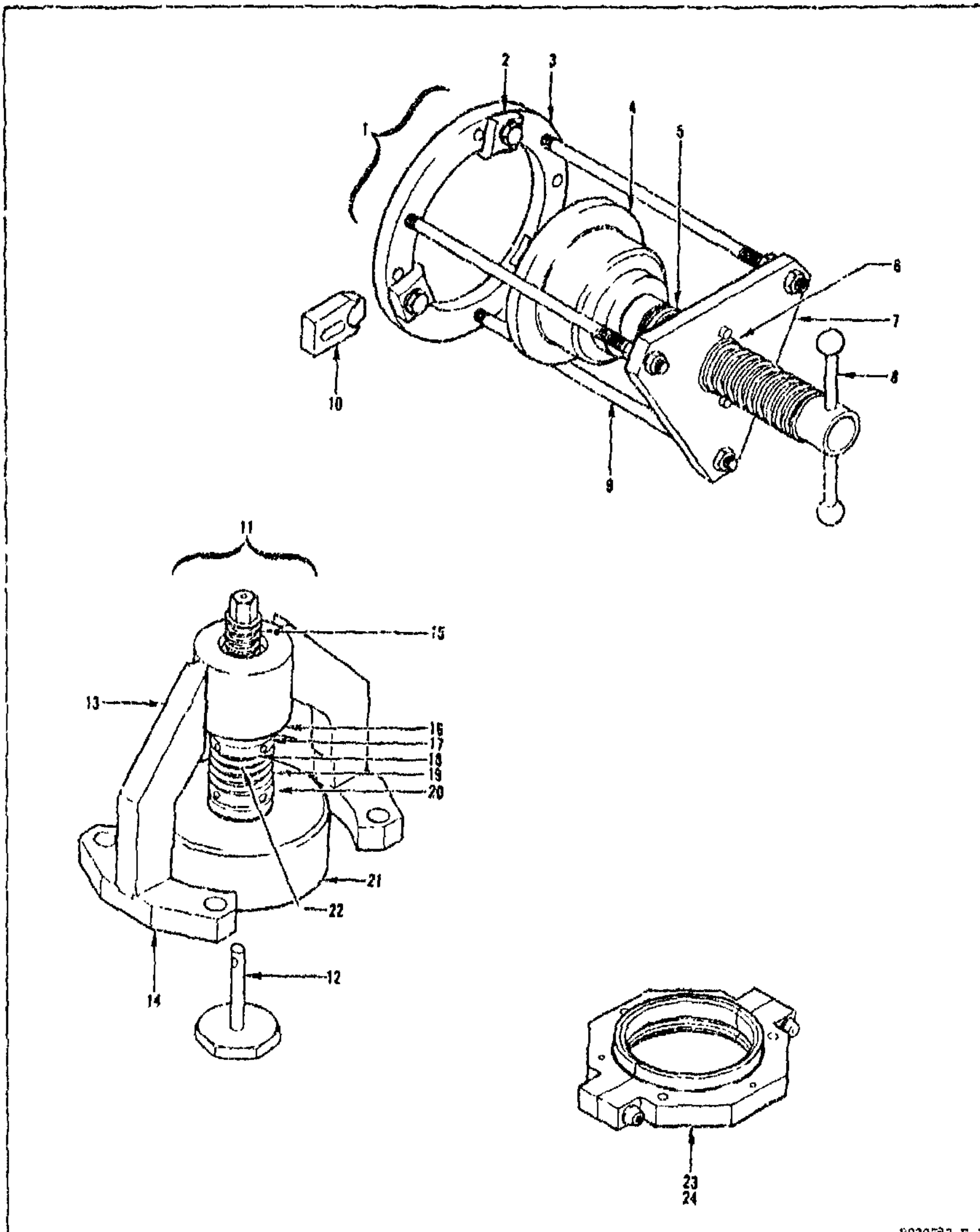



Figure 12-13. Main Propellant and Oxidizer Turbine Bypass Valves Maintenance Set (Sheet 1 of 7)

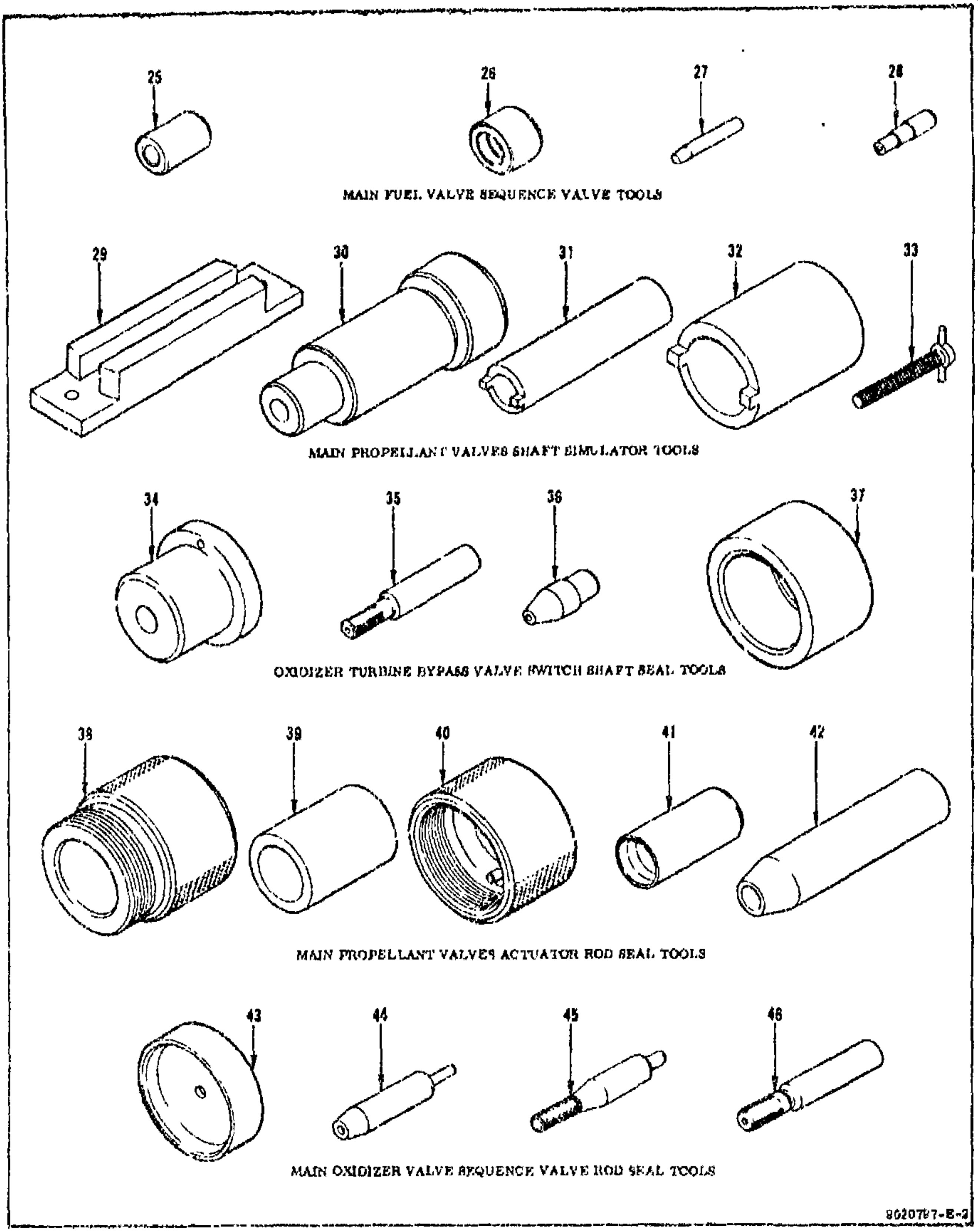



Figure 12-13. Main Propellant and Oxidizer Turbine Bypass Valves Maintenance Set (Sheet 2 of 7)

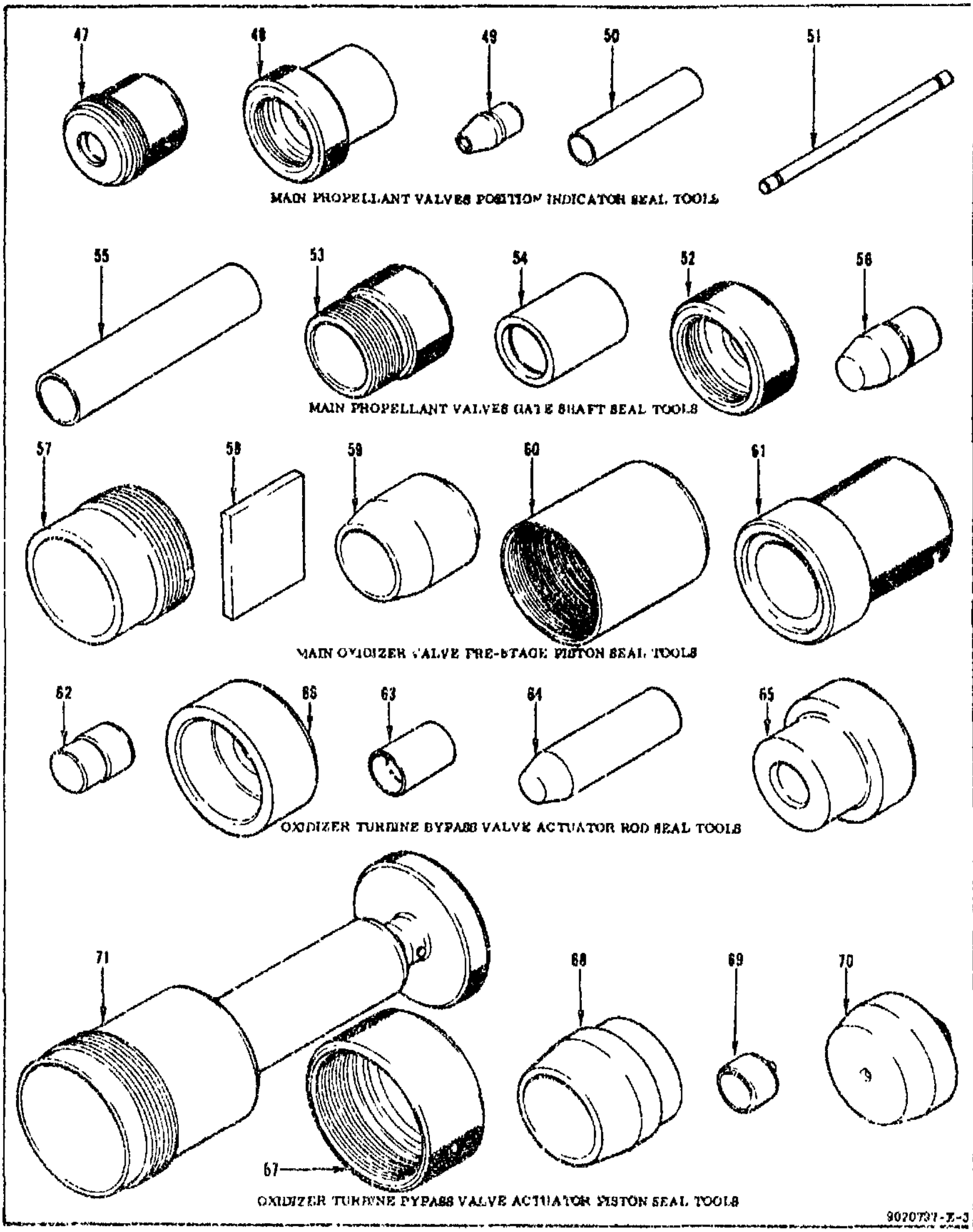



Figure 12-13. Main Propellant and Oxidizer Turbine Bypass Valves Maintenance Set (Sheet 3 of 7)

| Index Number | Part Number | Nomenclature | Source and Recoverability Code (Refer to section I.) |
|---|---|---|---|
| | 9020797 | Main Propellant and Oxidizer Turbine Bypass Valves Maintenance Set | F-1 |
| | 9022326 | Compressor Kit | F-1 |
| | NH1-177-8 | Container | F-3 |
| 1 | 9022327 | Compressor | F-1 |
| 2 | 9022328 | Lug | F-3 |
| 3 | 9022329 | Support | F-3 |
| 4 | 9022330 | Adapter | F-3 |
| 5 | 9022331 | Shaft | F-3 |
| 6 | 9022332 | Bushing | F-3 |
| 7 | 9022333 | Bracket | F-3 |
| 8 | 9022334 | Handle | F-3 |
| | H-4 | Ball | F-3 |
| 9 | 9022335 | Rod | F-3 |
| | AN315-6 | Hex Nut | F-3 |
| | AN101315 | Bolt | F-3 |
| | LD153-0013-0004 | Washer | F-3 |
| | NAS1101C4-18 | Screw | F-3 |
| 10 | 9025374 | Lug | F-3 |
| | 9022339 | Main Propellant Valves Seal Compression Tool Kit | F-1 |
| | NH1-177-7 | Container | F-3 |
| 11 | 9024864 | Compression Tool | F-1 |
| 12 | 9024890 | Pin | F-3 |
| 13 | 9024891 | Frame | F-3 |
| 14 | 9024892 | Adapter | F-3 |
| | NAS1351-6-14P | Screw | F-3 |
| 15 | 9024893 | Shaft | F-3 |
| 16 | 9024894 | Insert | F-3 |
| | NAS1351-4-10P | Screw | F-3 |
| 17 | 9024895 | Locknut | F-3 |
| 18 | 9024896 | Retainer | F-3 |
| 19 | 9024897 | Spring | F-3 |
| 20 | 9024898 | Swivel | F-3 |
| | LT-18 | Bearing | F-3 |
| 21 | 9024899 | Disk | F-3 |
| 22 | NAS1352-06016 | Screw | F-3 |
| | AN340C6 | Nut | F-3 |
| | 9024900 | Disk | F-3 |

Figure 12-13. Main Propellant and Oxidizer Turbine Bypass Valves Maintenance Set (Sheet 4 of 7)

| Index Number | Part Number | Nomenclature | Source and Recoverability Code (Refer to section I.) |
|---|---|---|---|
| | AN9-14A | Bolt | F-3 |
| | LD153-0011-0024 | Washer | F-3 |
| | 9022344 | Main Propellant Valves Actuator Piston Seal Tool Kit | F-1 |
| | VD192-0002-0015 | Container | F-3 |
| 23 | 9025376 | Lipseal Tool | F-3 |
| 24 | 9025376-11 | Lipseal Tool | F-3 |
| | LD153-0011-0017 | Washer | F-3 |
| | MS16638-19 | Screw | F-3 |
| | NAS1351-3-16 | Screw | F-3 |
| | NAS1351-4-16 | Screw | F-3 |
| | RD153-0110-0016 | Washer | F-3 |
| | RD153-0110-0030 | Washer | F-3 |
| | 9022340 | Main Fuel Valve Sequence Valve Seal Tool Kit | F-1 |
| | VD192-0002-0844 | Container | F-3 |
| 25 | 9025355 | Former | F-3 |
| 26 | 9025356 | Body | F-3 |
| 27 | 9025357 | Nose | F-3 |
| 28 | 9024851 | Plug End | F-3 |
| | 9022345 | Main Propellant Valves Shaft Simulator Adapter Tool Kit | F-1 |
| | VD192-0002-1286 | Container | F-3 |
| 29 | 9024850 | Holding Bar | F-3 |
| 30 | 9025351 | Idler Shaft Simulator | F-3 |
| 31 | 9025352 | Sequence Rod Wrench | F-3 |
| 32 | 9025354 | Clevis Nut Wrench | F-3 |
| 33 | 9025378 | Screw | F-3 |
| | AN350-4 | Wing Nut | F-3 |
| | 9024817 | Oxidizer Turbine Bypass Valve Switch Shaft Seal Tool Kit | F-1 |
| | VD192-0002-0844 | Container | F-3 |
| 34 | 9025364 | Guide | |
| 35 | 9025365 | Nose | |
| 36 | 9025366 | End Plug | |
| 37 | 9024492 | Bushing Guide | |
| | 9024842 | Main Propellant Valves Actuator Rod Seal Tool Kit | F-1 |
| | VD192-0002-0884 | Container | F-3 |

Figure 12-13. Main Propellant and Oxidizer Turbine Bypass Valves Maintenance Set (Sheet 5 of 7)

| Index Number | Part Number | Nomenclature | Source and Recoverability Code (Refer to section I.) |
|---|---|---|---|
| 38 | 9024843 | Body | F-3 |
| 39 | 9024844 | Sleeve | F-3 |
| 40 | 9024845 | Nut | F-3 |
| 41 | 9024846 | Nose Adapter | F-3 |
| 42 | 9024847 | Nose | F-3 |
| | 9024868 | Main Oxidizer Valve Sequence Valve Rod Seal Tool Kit | F-1 |
| | VD192-0002-0884 | Container | F-3 |
| 43 | 9024848 | Pin Holder | F-3 |
| 44 | 9024849 | Pilot Pin | F-3 |
| 45 | 9024869 | Forming Tool | F-3 |
| 46 | 9024870 | Piloting Tool | F-3 |
| | 9024871 | Main Propellant Valves Position Indicator Seal Tool Kit | F-1 |
| | VD192-0002-0884 | Container | F-3 |
| 47 | 9024872 | Body | F-3 |
| 48 | 9024873 | Nut | F-3 |
| 49 | 9024874 | Nose | F-3 |
| 50 | 9024875 | Shaft | F-3 |
| 51 | 9024876 | Rod | F-3 |
| | MS29513-007 | Packing | |
| | 9024877 | Main Propellant Valves Gate Shaft Seal Tool Kit | F-1 |
| | VD192-0002-0884 | Container | F-3 |
| 52 | 9024079 | Nut | F-3 |
| 53 | 9024879 | Ring | F-3 |
| 54 | 9024880 | Sleeve | F-3 |
| 55 | 9024881 | Shaft | F-3 |
| 56 | 9024882 | Nose | F-3 |
| | 9024883 | Main Oxidizer Valve Pre-Stage Piston Seal Tool Kit | F-1 |
| | VD192-0002-0884 | Container | F-3 |
| 57 | 9024884 | Insert | F-3 |
| 58 | 9024885 | Spanner Plate | F-3 |
| 59 | 9024886 | Nose | F-3 |
| 60 | 9024887 | Nut | F-3 |
| 61 | 9024888 | Jacking Screw | F-3 |
| | 9025358 | Oxidizer Turbine Bypass Valve Actuator Rod Seal Tool Kit | F-1 |
| | VD192-0002-0884 | Container | F-3 |

Figure 12-13. Main Propellant and Oxidizer Turbine Bypass Valves Maintenance Set (Sheet 6 of 7)

| Index Number | Part Number | Nomenclature | Source and Recoverability Code (Refer to section I.) |
|---|---|---|---|
| 62 | 9025359 | Pusher | F-3 |
| 63 | 9025360 | Transfer Tube | F-3 |
| 64 | 9025361 | Nose | F-3 |
| 65 | 9025362 | Guide | F-3 |
| 66 | 9025363 | Socket | F-3 |
| | 9025367 | Oxidizer Turbine Bypass Valve Actuator Piston Seal Tool Kit | F-1 |
| | VD192-0002-1286 | Container | F-3 |
| 67 | 9025369 | Nut | F-3 |
| 68 | 9025371 | Nose | F-3 |
| 69 | 9025373 | Slider Plug | F-3 |
| 70 | 9025375 | Nose | F-3 |
| 71 | 9024493 | Piston Guide | F-1 |
| | 9025368 | Guide | F-3 |
| | 9025370 | Knob | F-3 |
| | 9025372 | Screw | F-3 |
| | MS171591 | Pin | F-3 |

Figure 12-13. Main Propellant and Oxidizer Turbine Bypass Valves Maintenance Set (Sheet 7 of 7)

12-41. MAINTENANCE OF MAIN PROPELLANT AND OXIDIZER TURBINE BY-PASS VALVES MAINTENANCE SET.

12-42. Maintenance tasks required on the maintenance set are listed in figure 12-14. The information presented lists the tasks to be performed, when the tasks are to be performed and where the data support for the tasks will be found. When replacing tools or parts, see figure 12-13 for identification. No special instructions are necessary for maintenance tasks.

12-43. MAINTENANCE OF MAIN PROPELLANT AND OXIDIZER TURBINE BY-PASS VALVES MAINTENANCE SET COMPONENTS.

12-44. Maintenance of components consists of disassembling and assembling the main propellant and oxidizer turbine bypass valves compression tool.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect maintenance set for completeness | X | X | | | See figure 12-13. |
| Inspect tools for nicks, scratches and burs | X | X | | | Replace defective part or tool. See figure 12-13. |
| Inspect compressor tool shaft for galling indicating dry film lubricant worn from threads | X | X | | | Replace shaft. See figure 12-13. |
| Inspect seal compression tool shaft and swivel for galling indicating dry film lubricant worn from threads and swivel | X | X | | | Replace defective part. See figure 12-13. Refer to paragraphs 12-45 and 12-46. |
| Inspect bearing for freedom of movement | X | X | | | Replace defective bearing. See figure 12-13. Refer to paragraphs 12-45 and 12-46. |
| Inspect seal forming tools for nicks, scratches and burs on critical surfaces | X | X | | | Replace defective part. See figure 12-13. |
| Inspect protective surfaces for damage | | X | | | Replace defective part or tool. See figure 12-13. |
| Inspect tools for damaged threads | X | X | | | Replace defective tool. See figure 12-13. |
| Clean tools | | X | X | | Refer to Cleaning in Volume I, section I. |
| Prepare maintenance set for storage. | | | X | | Refer to paragraph 12-47. |

Figure 12-14. Maintenance Requirements for Main Propellant and Oxidizer Turbine Bypass Valves Maintenance Set

12-45. DISASSEMBLING COMPRESSION TOOL. Disassemble compression tool as follows:

a. Turn shaft into frame until shaft can be removed.

b. Loose · locknut and remove from shaft. Remove spring from shaft.

c. Remove nut and screw holding pin to shaft. Remove pin, disk, bearing, and swivel.

d. Remove screws attaching insert to frame. Remove insert.

e. Remove screws attaching adapters to frame. Remove adapter.

12-46. ASSEMBLING COMPRESSION TOOL. Assemble compression tool as follows:

a. Install adapter to frame. Torque screws to 160-190 inch-pounds.

b. Install insert into frame. Torque screws to 40-50 inch-pounds.

c. Assemble swivel, bearing, disk, and pin on shaft.

d. Install screw and nut retaining pin to shaft. Torque nut 20-25 inch-pounds.

e. Place spring on shaft until spring contacts swivel. Install retainer on shaft and tighten until a spring dimension of 1.75 inches is obtained.

f. Install locknut. Tighten against retainer.

g. Install shaft into frame.

12-47. STORING MAIN PROPELLANT AND OXIDIZER TURBINE BYPASS VALVES MAINTENANCE SET.

12-48. Prepare maintenance set for storage as follows:

a. Clean tools. Refer to Cleaning in Volume I, section I.

b. Mate the plug end tool and nose tool of the main fuel valve seal tool kit.

c. Place tools in proper container and ensure tools do not contact each other. Refer to figure 12-13 for proper container.

CAUTION

Tools contacting each other can damage finished surface of the tools.

d. Secure container and store maintenance set.

12-49. DESCRIPTION OF VALVES BUILDUP FIXTURE KIT 9022337.

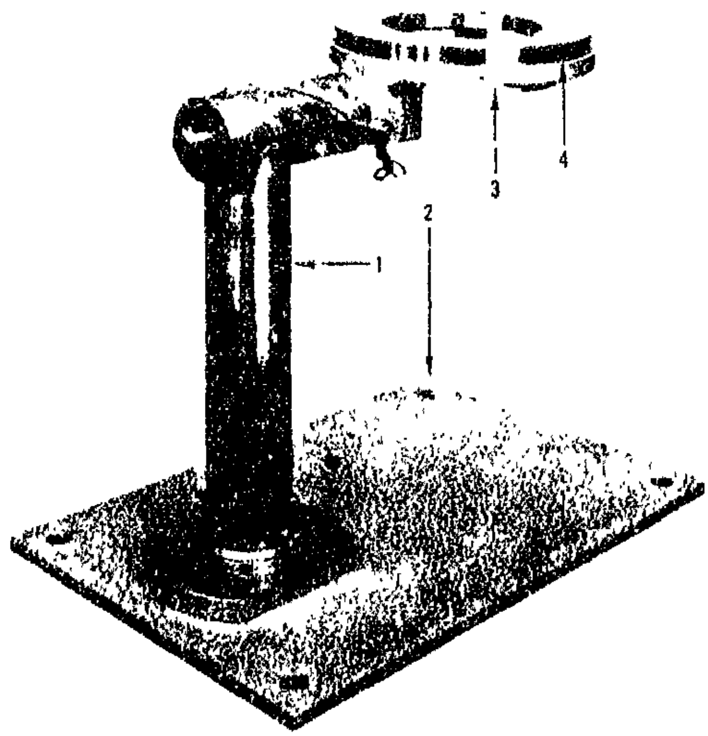
12-50. The valves buildup fixture kit is used to support the main oxidizer, main fuel and oxidizer turbine bypass valve during assembly, disassembly, and repair. Figure 12-15 illustrates the buildup fixture assembled. The buildup fixture consists of a base plate, column, support ring, and an adapter. The base plate is a flat plate with holes for bench mounting and is used to stabilize the buildup fixture. The cylindrical column has a flanged end to provide attachment to the base plate. A tube with positioning holes on the opposite end of the column allows the bar of the support ring to be inserted and rotated. By alining the holes in the column and support ring, the support ring can be rotated to varied positions and locked into position by an attached lockpin. The valves are mounted on the ring of the support ring and adapter ring. Both rings have a protective surface on which the valves are mounted. The buildup fixture is disassembled for storage in the kit container.

12-51. MAINTENANCE OF VALVES BUILDUP FIXTURE KIT.

WARNING

The following specifies adhesive EC776, which is flammable and must not be used near heat, sparks, or open flame. It is toxic. Inhalation of its vapors or prolonged contact with the adhesive can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

12-52. Maintenance tasks required on the fixture kit are listed in figure 12-16. The information presented lists the tasks to be performed, when the tasks are to be performed, and where the data support for the tasks may be found. When replacing parts, see figure 12-15 for identification. The only special maintenance requirements consist of welding the column and support ring and replacing the protective surfaces. Repair cracked welds by grinding out the crack and rewelding to original weld contour using weld rod (MIL-E-16053, Type 5183) on the support ring and stainless steel weld rod (MIL-R-5031, Class A) on the column. Iridite the area of the support ring affected by the weld. Cement the etched side of protective surface, etched one side teflon sheet RB0130-008 (Rocketdyne), on the support ring, adapter ring and protective washer with EC-776 (Minnesota Mining and Mfg), or equivalent.




| Index Number | Part Number | Nomenclature | Source and Recoverability Code (Refer to section I.) |
|---|---|---|---|
| | 9022337 | Valves Buildup Fixture Kit | F-1 |
| | NH1-177-6 | Container | F-3 |
| | 9024805 | Valves Buildup Fixture | F-1 |
| 1 | 9024806 | Column | F-1 |
| 2 | 9024807 | Base Plate | F-3 |
| 3 | 9024808 | Support Ring | F-1 |
| | NAS1335C5C25D | Pin | F-3 |
| | RD191-2002-1201 | Cable | F-3 |
| | 28-1-C | Sleeve | F-3 |
| | MS16638-29 | Screw | F-3 |
| | AN507-524R24 | Screw | F-3 |
| | NAS679A5 | Nut | F-3 |
| | LD153-0010-0011 | Washer | F-3 |
| | 9024809 | Protective Washer | F-3 |

Figure 12-15. Valves Buildup Fixture Kit (Sheet 1 of 2)

| Index Number | Part Number | Nomenclature | Source and Recoverability Code (Refer to section I.) |
|---|---|---|---|
| 4 | 9024810 | Adapter Ring | F-1 |
| | AN7-7A | Bolt | F-3 |
| | AN8-11A | Bolt | F-3 |
| | AN9-11A | Bolt | F-3 |
| | AN101135 | Bolt | F-3 |
| | LD153-0010-0010 | Washer | F-3 |
| | LD153-0010-0014 | Washer | F-3 |
| | LD153-0010-0018 | Washer | F-3 |
| | LD153-0010-0020 | Washer | F-3 |
| | NAS679A4W | Nut | F-3 |
| | ND112-0001-0816 | Washer | F-3 |
| | RD153-0115-0032 | Washer | F-3 |

Figure 12-15. Valves Buildup Fixture Kit (Sheet 2 of 2)

12-53. STORING VALVES BUILDUP FIXTURE KIT.

12-54. Prepare fixture kit for storage as follows:

a. Disassemble buildup fixture.

b. Clean buildup fixture. Refer to Cleaning in Volume I, section I.

c. Place buildup fixture components in container. Refer to figure 12-15 for container.

NOTE

Protective packaging on buildup fixture parts may be removed to fit parts in container.

d. Secure container. Store valves buildup fixture kit.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect kit for completeness. | X | X | | | See figure 12-15. |
| Inspect ball lockpin for operation. | X | X | | | Replace inoperative pins. See figure 12-15. |
| Inspect for frayed or broken cables. | X | X | | | Replace damaged cables. See figure 12-15. |
| Inspect column and support ring for cracked welds. | X | X | | | Repair cracked welds. Refer to paragraph 12-51. |
| Inspect protective surface of support ring, adapter ring, and protective washer for damage. | X | X | | | Replace damaged protective surface. Refer to paragraph 12-51. |
| Clean buildup fixture. | | X | | | Refer to Cleaning in Volume I, section I. |
| Prepare fixture kit for storage. | | | X | | Refer to paragraph 12-53. |

Figure 12-16. Maintenance Requirements for Valves Buildup Fixture Kit

12-55. DESCRIPTION OF PURGE CONTROL AND FAST SHUTDOWN VALVE MAINTENANCE KIT 9024725.

12-56. The maintenance kit (figure 12-17) is used for maintenance, repair, and assembly of the purge control and fast shutdown valves. The kit contains a fixture, spacer, bolts and spring compressor plate. The fixture, which incorporates a protective surface for valve mounting, provides for clamping the valve in a vise during maintenance. The ring-shaped spacer positions the shaft during

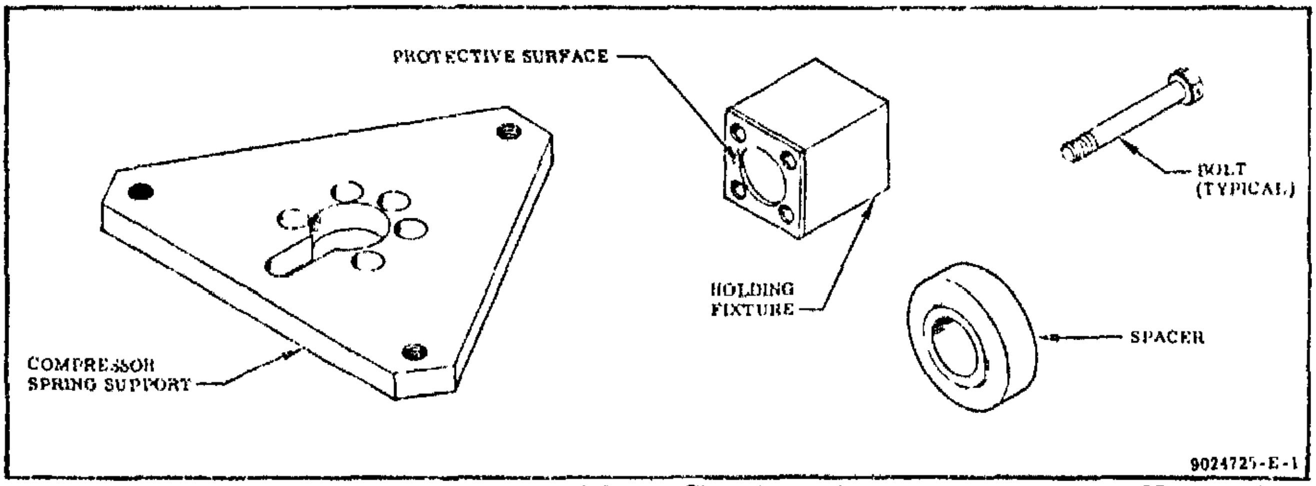



Figure 12-17. Purge Control and Fast Shutdown Valve Maintenance Kit Tools

assembly of valve diaphragms. The triangular-shaped spring compressor plate, is used with spring compressor 9022326 from the Main Propellant and Oxidizer Turbine Bypass Valves Maintenance Set. The spring compressor plate is interchanged with the compressor support on the spring compressor, and used to compress the valve spring and hold the dome in position while torquing. A reuseable container is provided with the kit to provide storage for the tools.

## 12-57. MAINTENANCE OF PURGE CONTROL AND FAST SHUTDOWN VALVE MAINTENANCE KIT.

WARNING

The following specifies adhesive EC776, which is flammable and must not be used near heat, sparks, or open flame. It is toxic. Inhalation of its vapors or prolonged contact with the adhesive can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

12-58. Maintenance tasks required on the kit are listed in figure 12-18. Information presented lists the tasks to be performed, when the tasks must be performed, and where data support is found. Maintenance consists of cementing the etched side of the protective surface, Teflon sheet AMS3651 (etched one side), to holding fixture with cement EC776 (Minnesota Mining and Mfg), or equivalent.

## 12-59. PREPARING MAINTENANCE KIT FOR STORAGE.

12-60. Prepare kit for storage by cleaning tools. Refer to Cleaning in Volume I, section I. Place tools in container provided with kit and make sure tools do not touch each other. Secure container.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect maintenance kit for completeness. | X | X | | | See figure 12-17. |
| Inspect holding fixture for damaged protective surface. | X | X | | | Replace protective surface. Refer to paragraph 12-57. |
| Inspect compressor spring support and spacer for nicks, burs, and scratches. | X | X | | | Replace damaged tool. |
| Clean maintenance kit tools. | | | | X | As required to maintain level of cleanness. Refer to Cleaning in Volume I, section I. nents in section I. |
| Prepare kit for storage. | | | | X | Refer to paragraph 12-59. |

Figure 12-18. Maintenance Requirements for Purge Control and Fast Shutdown Valve Maintenance Kit

# SECTION XIII

# VIBRATION SAFETY CUTOFF TEST SET 9024498

WARNING

VIBRATION SAFETY CUTOFF TEST SET 9024498 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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## 13-1. DESCRIPTION AND LEADING PARTICULARS OF VIBRATION SAFETY CUTOFF TEST SET.

13-2. The vibration safety cutoff test set (figure 13-1) is used to perform function-tests of the extended range vibration safety cutoff set. The test set, consisting of a test panel and wire harness, is contained in a portable carrying case. Incorporated on the panel are test lights, switches, test jacks, circuit breaker, and potentiometer. The terminal board, capacitor, wire harness connector receptacle, and electrical circuitry are mounted on the back of the panel. The terminal board contains diodes, resistors, transistors, and circuitry. Quick-release studs attach the test panel to the bottom portion of the case. The wire harness is connected to the receptacle under the test panel and is an integral part of the test set. Connectors are provided on the wire harness, for connection to the panel being tested, and for 28 vdc power supply connection to the test set. The case cover is detachable to prevent interference when using the set. A pressure relief valve is incorporated into the case to equalize internal case pressure with atmospheric pressure. A storage area for the wire harness is provided in the case. The test set is 21.50 inches long, 12.00 inches wide, 7.50 inches deep, and weighs 20 pounds. The vibration safety cutoff test set is connected to the extended range safety cutoff set being tested. Power is supplied to the cutoff set, and monitor lights on the test set verify cutoff relay contact circuits. Actuating the test set

switches energizes the reset relay and the deactivation relay coils. With test leads connected between test set jacks, the cutoff set and other test equipment current is varied with the pulse width control testing the cutoff set timer and output switches. Information relative to the use of the vibration safety cutoff test set is in Technical Manual R-3825-5, Volume I.

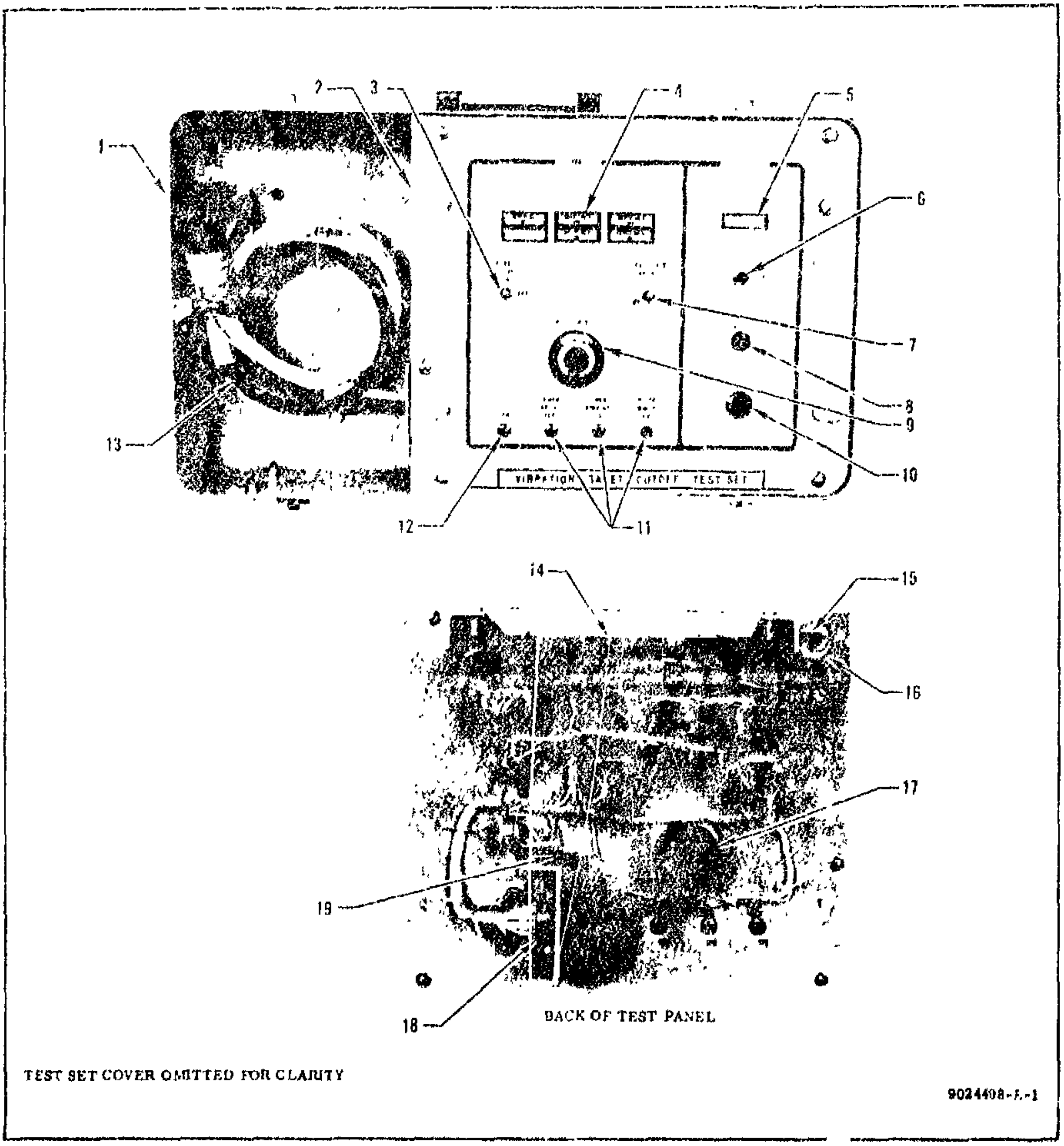



Figure 13-1. Vibration Safety Cutoff Test Set (Sheet 1 of 3)

| Index Number | Part Number | Nomenclature |
|---|---|---|
| | 9024498 | Vibration Safety Cutoff Test Set |
| 1 | 19-9024976 | Case |
| | 7C1-24 | Clamp |
| | AN515C6R12 | Screw |
| | NAS686C06 | Nutplate |
| | 212-12S | Stud Receptacle |
| 2 | 9024985 | Panel |
| | 2600-7S | Stud |
| | 2600-LW | Washer |
| | 1965-1 | Handle |
| | 1988-1 | Ferrule |
| | AN507C1032R8 | Screw |
| 3 | MS35059-24 | Switch |
| 4 | RD415-3005-0001 | Lampholder |
| | RD332-0003-0344 | Lens |
| | RD332-0003-0345 | Lens |
| | RD332-0003-0346 | Lens |
| | RD332-0003-0347 | Lens |
| | RD332-0003-0348 | Lens |
| | RD332-0003-0349 | Lens |
| | RD338-0001-0004 | Filter |
| | RD450-2001-0001 | Control |
| 5 | RD415-3001-0001 | Lampholder |
| | RD332-0003-341 | Lens |
| | RD338-0001-0004 | Filter |
| | RD450-2001-0001 | Control |
| 6 | MS35058-24 | Switch |
| 7 | MS35059-21 | Switch |
| 8 | 7274-2-2 | Circuit Breaker |
| 9 | 1326 | Microdial |
| 10 | MS25089-3C | Switch |
| 11 | 205 | Red Jack (TP1, TP2, TP3) |

Figure 13-1. Vibration Safety Cutoff Test Set (Sheet 2 of 3)

| Index Number | Part Number | Nomenclature |
|---|---|---|
| 12 | 205 | Black Jack (TP-4) |
| 13 | 9024987 | Wire Harness |
| | AN520C10R7 | Screw |
| | NAS679C3W | Nut |
| | LD153-0010-0007 | Washer |
| | NAS1397R12B | Clamp |
| 14 | 9024990 | Terminal Board |
| | AN515C8R16 | Screw |
| | NAS43DD-32 | Spacer |
| | LD153-0011-0010 | Washer |
| | NAS679C08W | Nut |
| 15 | 1947-1 | Terminal |
| | AN515C4R4 | Screw |
| | LD153-0011-0006 | Washer |
| | MS35333-19 | Lockwasher |
| 16 | TC-2505A | Capacitor |
| | TC-2505[(a)] | Capacitor |
| | AN515C6R6 | Screw |
| | LD153-0011-0008 | Washer |
| | NAS679C06W | Nut |
| 17 | AR5KL.25 | Potentiometer |
| 18 | MS3102R24-28S | Receptacle |
| | AN515C6R10 | Screw |
| | LD153-0011-0008 | Washer |
| | NAS679C06W | Nut |
| 19 | AN515C10R8 | Screw |
| | LD153-0010-0007 | Washer |
| | MS35333-39 | Lockwasher |
| | NAS679C3W | Nut |

(a) Allowable alternate

Figure 13-1. Vibration Safety Cutoff Test Set (Sheet 3 of 3)

## 13-3. MAINTENANCE OF VIBRATION SAFETY CUTOFF TEST SET.

13-4. Planned field maintenance required to ensure operation of the vibration safety cutoff test set is listed in figure 13-2. This figure outlines the tasks to be performed, when the tasks shall be performed, and where the data support for these tasks will be found. See figure 13-1 for identification of components and figure 13-3 for a list of test equipment required for function-testing the set.

## 13-5. FUNCTION-TESTING VIBRATION SAFETY CUTOFF TEST SET.

13-6. The vibration safety cutoff test set function-test consists of a continuity test, lamp test, and a voltage measurement test. To function-test the vibration safety cutoff test set, proceed to figure 13-3. Refer to electrical schematic, figure 13-4, and wiring diagrams. figures 13-5 and 13-6, as an aid in isolating malfunctions. If results other than those specified are obtained, terminate the test, isolate the malfunction, and remove and replace malfunctioning component.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect test set for completeness | X | X | | | See figure 13-1. |
| Inspect wire harness connectors for absence of protective caps | X | X | | | Clean. Refer to R-3825-5, Volume I. |
| Inspect wire harness for broken or frayed insulation, broken wires, and broken connectors | X | X | | | Repair wire harness. Refer to paragraph 13-16. |
| Inspect test panel for scratches and chipped paint | X | X | | | Paint damaged surface. Refer to paragraph 13-15. |
| Inspect test panel for broken test lamps, switches, jacks, and potent neter dial | X | X | | | Remove and replace damaged component. Refer to paragraphs 13-13 and 13-14. |
| Inspect case for broken latches and handle | X | X | | | Remove and replace damaged component. Refer to paragraph 13-17 and figure 13-1. |
| Inspect case rubber seal for damage | X | X | | | Replace test set case. |
| Function-test vibration safety cutoff test set | X | | | X | Every 12 months or suspected malfunction. Refer to paragraph 13-5. |
| Clean test set | | | X | | Refer to R-3825-5, Volume I. |
| Prepare test set for storage | | | X | | Refer to paragraph 13-18. |

**Figure 13-2. Maintenance Requirements for Vibration Safety Cutoff Test Set**

| Step | Operation | Results |
|---|---|---|
| 1 | Obtain the following test equipment:<br>(a) Voltohmmeter, Model 260 (Simpson), or equivalent.<br>(b) Oscilloscope, Model 535 with a 53/54C plug-in unit (Tektronix), or equivalent.<br>(c) Power supply, 26-30 vdc with less than 2 percent ripple under a load of 2 amperes; and regulation within 1 percent.<br>(d) Test leads equipped with banana jacks on both ends.<br>(e) Test leads equipped with banana jack at one end and a 20-gage pin at the other end to fit socket of connector P1.<br>(f) Resistor, 700 ohms ±20 percent, 2 watts. | |
| 2 | Remove test set cover. | |
| 3 | Remove protective cap from electrical harness connector. | |
| NOTE: | Whenever this procedure requires the use of test equipment, and unless noted otherwise, the test equipment is to be deactivated or disconnected before proceeding to the next step. | |
| 4 | Check continuity between:<br>(a) E1 on wire harness and panel lifting handle.<br>(b) P1-E and PULSE WIDTH TEST jack.<br>(c) P1-A and COM jack. | Less than 1 ohm. |
| 5 | Move DEACTIVATE RELAY switch to + (plus) | None. |

Figure 13-3. Function-Testing Vibration Safety Cutoff Test Set (Sheet 1 of 5)

| Step | Operation | Results |
|---|---|---|
| 6 | Check continuity between P1-H and COM jack. | Less than 1 ohm. |
| 7 | Move DEACTIVATE RELAY to - (minus). | None. |
| 8 | Check continuity between P1-F and COM jack. | Less than 1 ohm. |
| 9 | Move RESET RELAY switch to ON. | None. |
| 10 | Check for continuity between P1-K and COM jack. | Less than 1 ohm. |
| 11 | Move all switches to OFF. | None. |
| 12 | Connect connector P5 to power supply. | None. |
| 13 | Energize power supply and adjust to 26-30 vdc. | None. |
| 14 | Depress POWER 2 AMPS circuit breaker. | None. |
| 15 | Momentarily depress LAMP TEST switch. | All lights momentarily on. |
| 16 | Move POWER switch to ON. | 28 VDC POWER light on. |
| 17 | Pull out POWER 2 AMPS circuit breaker. | 28 VDC POWER light off. |
| 18 | Depress POWER 2 AMPS circuit breaker. | 28 VDC POWER light on. |
| 19 | Momentarily connect a test lead between P1-C and the following: | The following lights come on when test lead is connected to respective contact: |
| | P1-D | CUTOFF NO. 1 OFF light. |

Figure 13-3. Function-Testing Vibration Safety Cutoff Test Set (Sheet 2 of 5)

| Step | Operation | Results |
|---|---|---|
| 19 | P1-E | CUTOFF NO. 1 ON light. |
| | P1-L | CUTOFF NO. 2 OFF light. |
| | P1-M | CUTOFF NO. 2 ON light. |
| | P1-P | CUTOFF NO. 3 OFF light. |
| | P1-S | CUTOFF NO. 3 ON light. |
| 20 | (Deleted) | |
| 21 | (Deleted) | |
| 22 | (Deleted) | |
| 23 | (Deleted) | |
| 24 | (Deleted) | |
| 25 | (Deleted) | |
| 26 | (Deleted) | |
| NOTE: | Steps 27 through 39 are used to perform the voltage measurement test. | |
| 27 | Measure voltage between: | 26-30 vdc. |
| | (a) P1-B (positive) and COM jack. | |
| | (b) P1-C (positive) and COM jack. | |
| | (c) P1-R (positive) and COM jack. | |
| | (d) P1-N (positive) and COM jack. | |
| 28 | Move DEACTIVATE RELAY switch to - (minus). | None. |

Figure 13-3. Function-Testing Vibration Safety Cutoff Test Set (Sheet 3 of 5)

| Step | Operation | Results |
|---|---|---|
| 29 | Measure voltage between P1-H (positive) and P1-F. | 26-30 vdc. |
| 30 | Rotate PULSE WIDTH control counterclockwise to 0. | None. |
| 31 | Connect the following test leads:<br>(a) Oscilloscope input terminal to TIMER STORAGE TEST jack.<br>(b) NEG terminal of oscilloscope to COM jack. | None. |
| 32 | Energize oscilloscope. | None. |
| NOTE: | Allow oscilloscope to warm up. | |
| 33 | Set oscilloscope SWEEP TIME to 500 ms/cm and AMPLITUDE at 5 v/cm. | None. |
| 34 | Rotate PULSE WIDTH control clockwise. | Oscilloscope indicates 10-16 volts peak to peak square wave. |
| NOTE: | The pulse will appear and its negative pulse width will increase as PULSE WIDTH control is rotated fully clockwise. | |
| 35 | Disconnect test lead from oscilloscope input terminal and TIMER STORAGE TEST jack. | |
| 36 | Connect a 700 ohm, 2 watt resistor in parallel with oscilloscope between P1-J (positive) and P1-K (negative). | None. |
| 37 | (Deleted) | |
| 38 | Connect test lead between TIMER STORAGE TEST jack and TIMER RELAY TEST. | None. |

Figure 13-3. Function-Testing Vibration Safety Cutoff Test Set (Sheet 4 of 5)

| Step | Operation | Results |
|---|---|---|
| 39 | Move RESET RELAY switch to ON. | Oscilloscope indicates 18-24 vdc. |
| 40 | Rotate PULSE WIDTH control counterclockwise. | Oscilloscope indicates 18-24 vdc peak to peak square wave. |
| NOTE: | The pulse will appear and its positive pulse will decrease as the PULSE WIDTH control is rotated fully counterclockwise. | |
| 41 | Deenergize oscilloscope. | None. |
| 42 | Move POWER switch to OFF. | 28 VDC POWER light off. |
| 43 | Deenergize power supply. | |
| 44 | Pull out POWER 2 AMPS circuit breaker. Move all switches to OFF. | None. |
| 45 | Secure test equipment from vibration safety cutoff test set. | None. |
| 46 | Install protective caps on electrical wire harness. | None. |
| 47 | Install test set cover. | |

Figure 13-3. Function-Testing Vibration Safety Cutoff Test Set (Sheet 5 of 5)

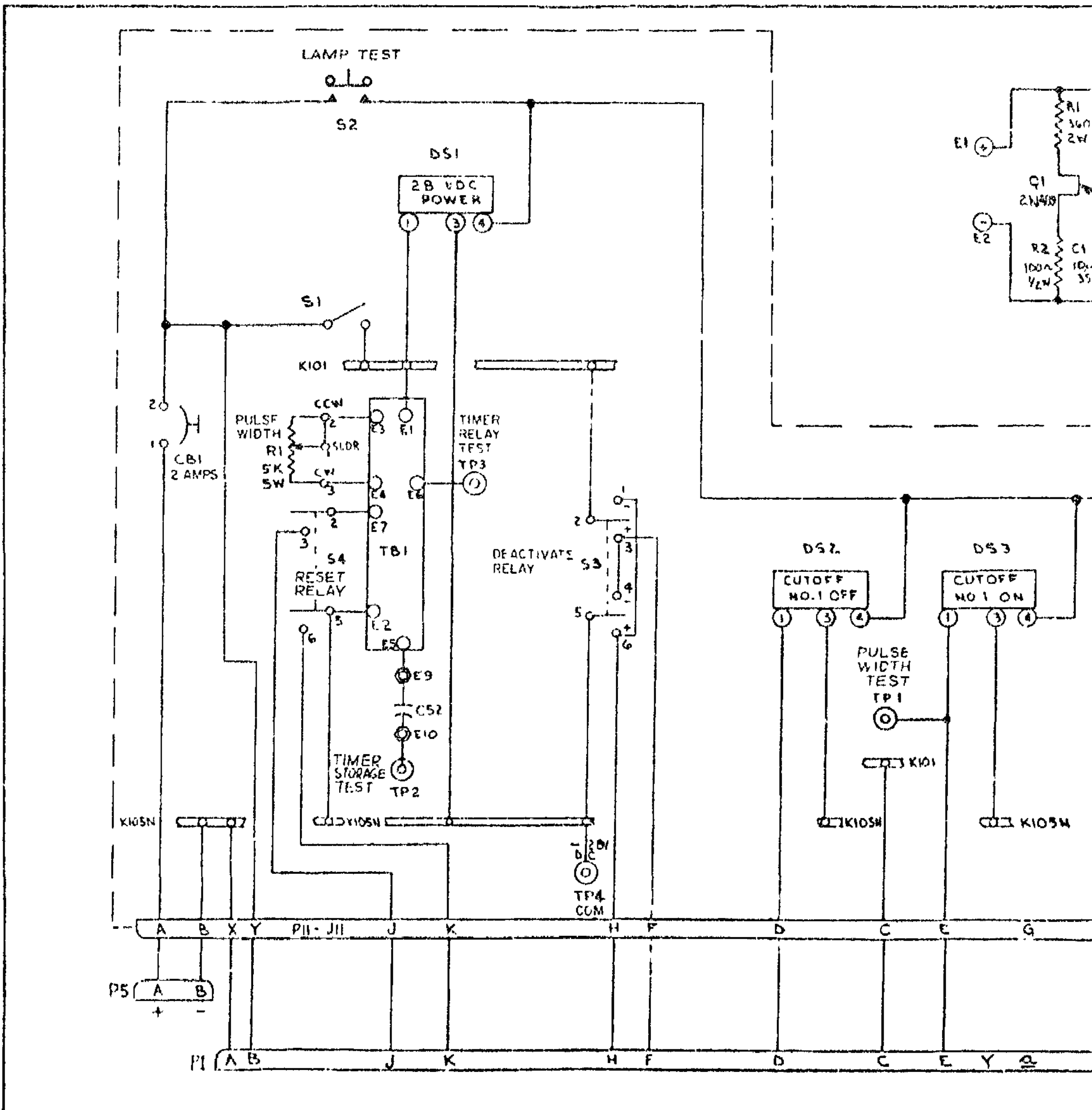
13-7. STORING VIBRATION SAFETY CUTOFF TEST SET.

13-8. Prepare the test set for storage as follows:

a. Clean test panel face, wire harness, and case. Refer to R-3825-5, Volume I.

b. Install protective caps on wire harness electrical connectors. Place cover on test set and secure.

c. Wrap test set with greaseproof barrier material (MIL-B-121, Grade A), or equivalent, and seal to protect test set from moisture and dust.



LAMP TEST
S2
DS1
28 VDC POWER
S1
K101
CB1
2 AMPS
PULSE WIDTH
R1
5K
5W
CCW
CW
SLDR
TB1
TIMER RELAY TEST
TP3
S4
RESET RELAY
DEACTIVATE RELAY
S3
C52
TIMER STORAGE TEST
TP2
TP4
COM
K105N
P11 - J11
P5
P1
DS2
CUTOFF NO.1 OFF
DS3
CUTOFF NO.1 ON
PULSE WIDTH TEST
TP1
K105N
Q1
2N40
R2
C1

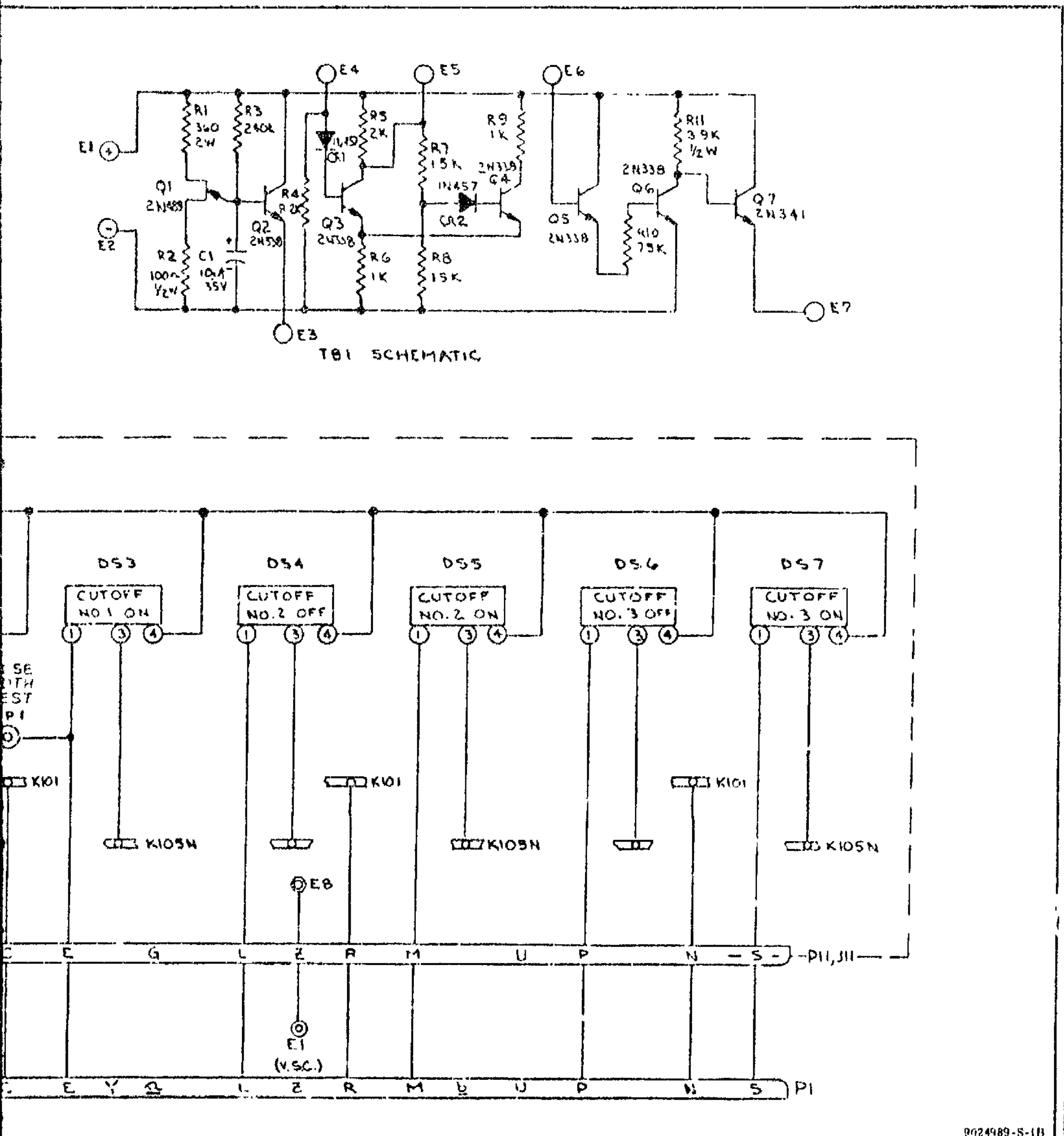



Figure 13-4. Vibration Safety Cutoff Test Set Electrical Schematic

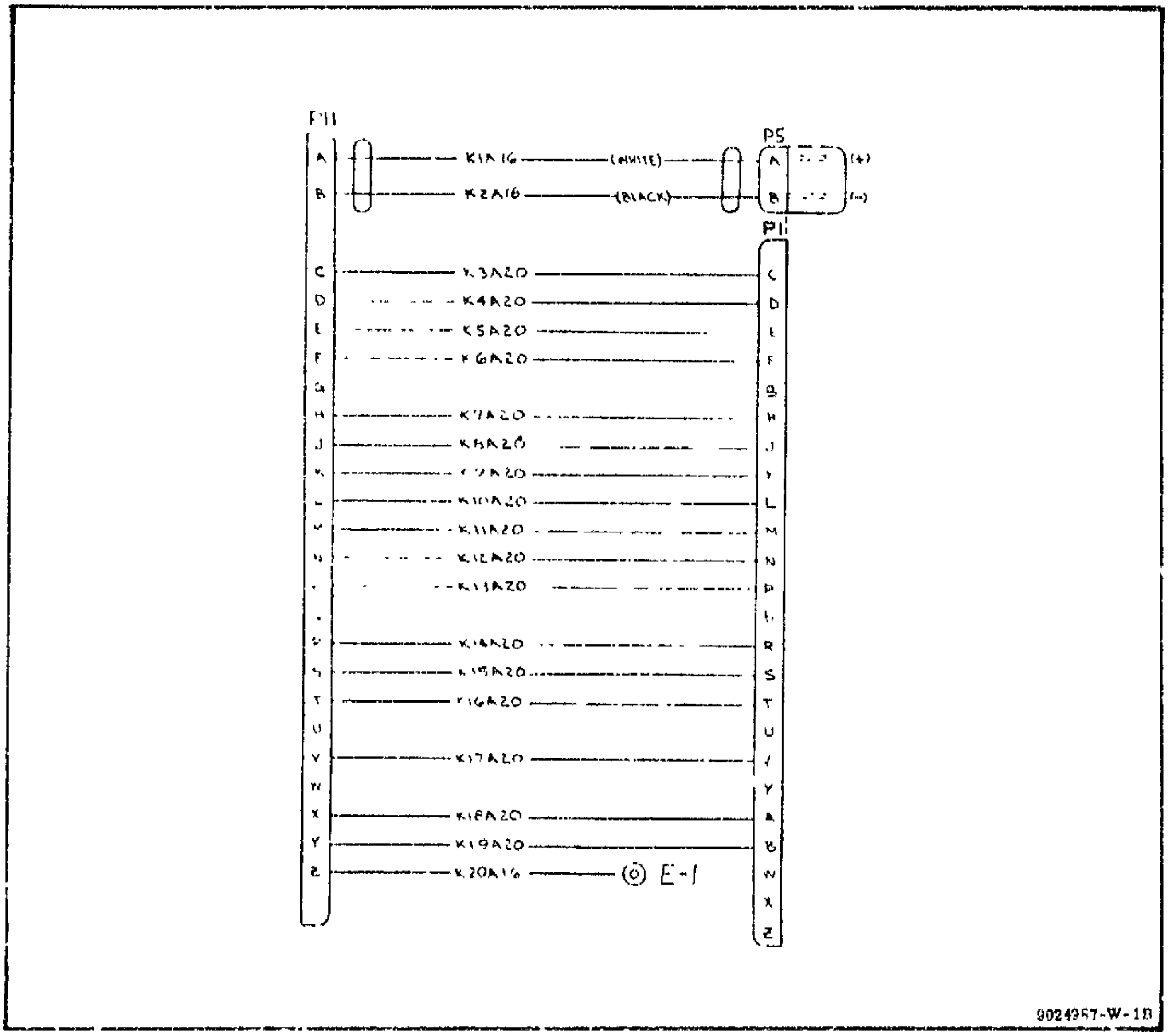



Figure 13-[illegible]. Vibration Safety Cutoff Test Set Wire Harness

## 13-9. MAINTENANCE OF VIBRATION SAFETY CUTOFF TEST SET COMPONENTS.

13-10. Maintenance of components consists of removing, installing, and replacing test panel components, painting test panel, repairing wire harness, repairing test set case, and preparing components for storage. See figure 13-1 to locate replaceable components and attaching hardware.

13-11. REMOVING TEST PANEL AND WIRE HARNESS. To remove test set test panel and wire harness, proceed as follows:

a. Loosen quick-release studs on face of panel.

b. Remove screws securing wire harness dust cover to case.

c. Release wire harness from securing clamp.

d. Remove bolts and clamps attaching wire harness to case.

e. Lift test panel from case.

f. Disconnect test set wire harness from receptacle under test panel.

13-12. INSTALLING TEST PANEL AND WIRE HARNESS. To install test set test panel and wire harness, proceed as follows:

a. Connect wire harness to test panel receptacle.

b. Install test panel in case and secure with quick-release studs.

c. Install wire harness attaching clamps. Refer to section I for applicable torque values.

d. Install wire harness dust cover. Refer to section I for applicable torque values.

e. Install wire harness in securing clamp.

13-13. REMOVING TEST PANEL COMPONENTS. Removing test panel components requires test panel to be removed from test set. Refer to paragraph 13-11 for test panel removal procedure. No special instructions are required to remove components from test panel. See figure 13-1 to locate components and attaching hardware.

13-14. INSTALLING TEST PANEL COMPONENTS. The only instructions required to install test panel components are: the potentiometer and microdial must be set to zero during installation, and a heat sink must be used when soldering wires to terminal board. See figures 13-1 and 13-6 to ensure proper component and wire installation. Refer to section I for applicable torque values. Perform a function-test on the test set per paragraph 13-5, upon completion of component installation.

13-15. PAINTING TEST PANEL. Paint test panel with gray enamel (Federal Specification TT-E-529), color 26440 (Federal Standard 595), except for a one-quarter-inch area around ground wire mounting hole in the wire harness receptacle mounting bracket.

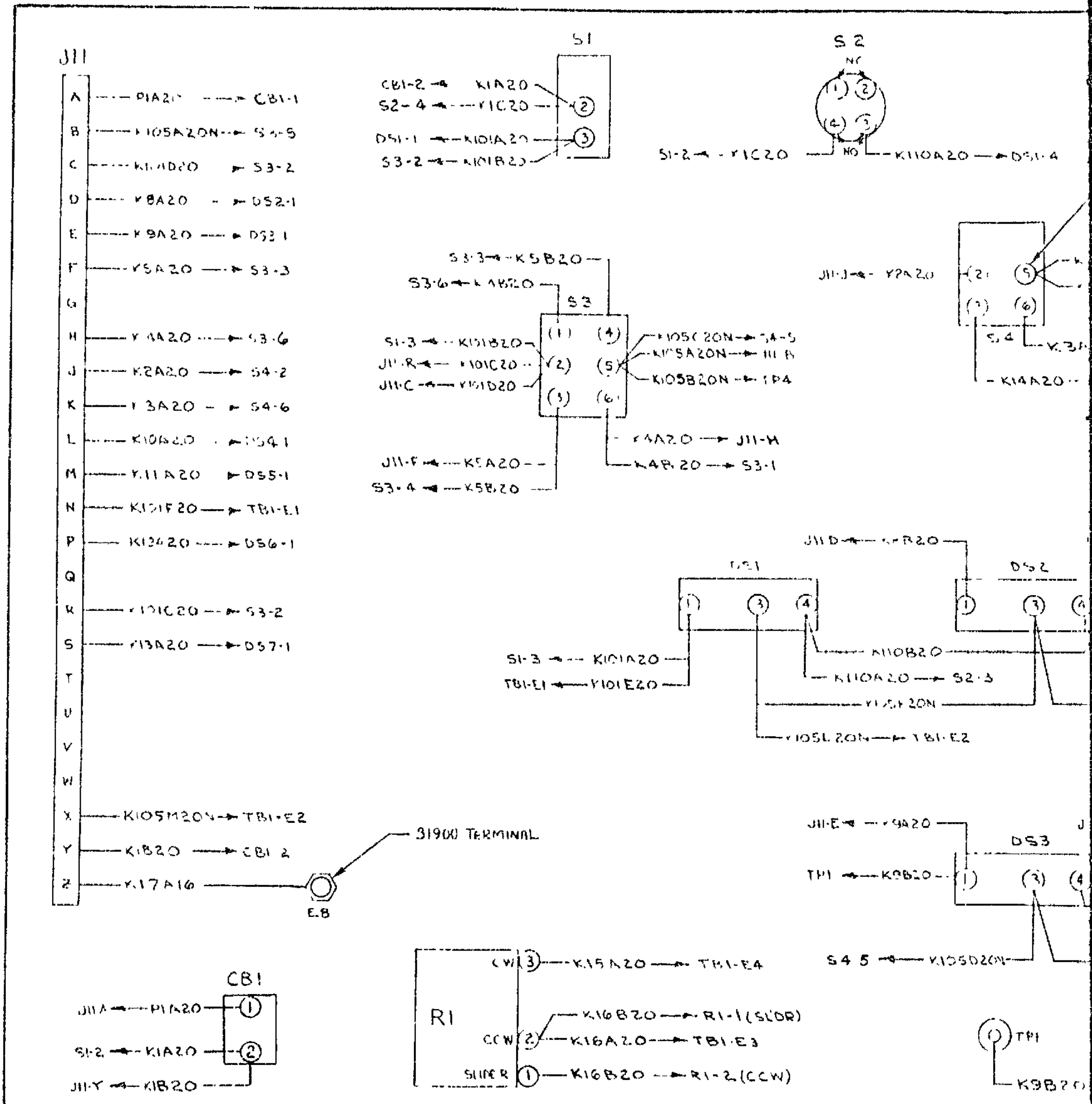
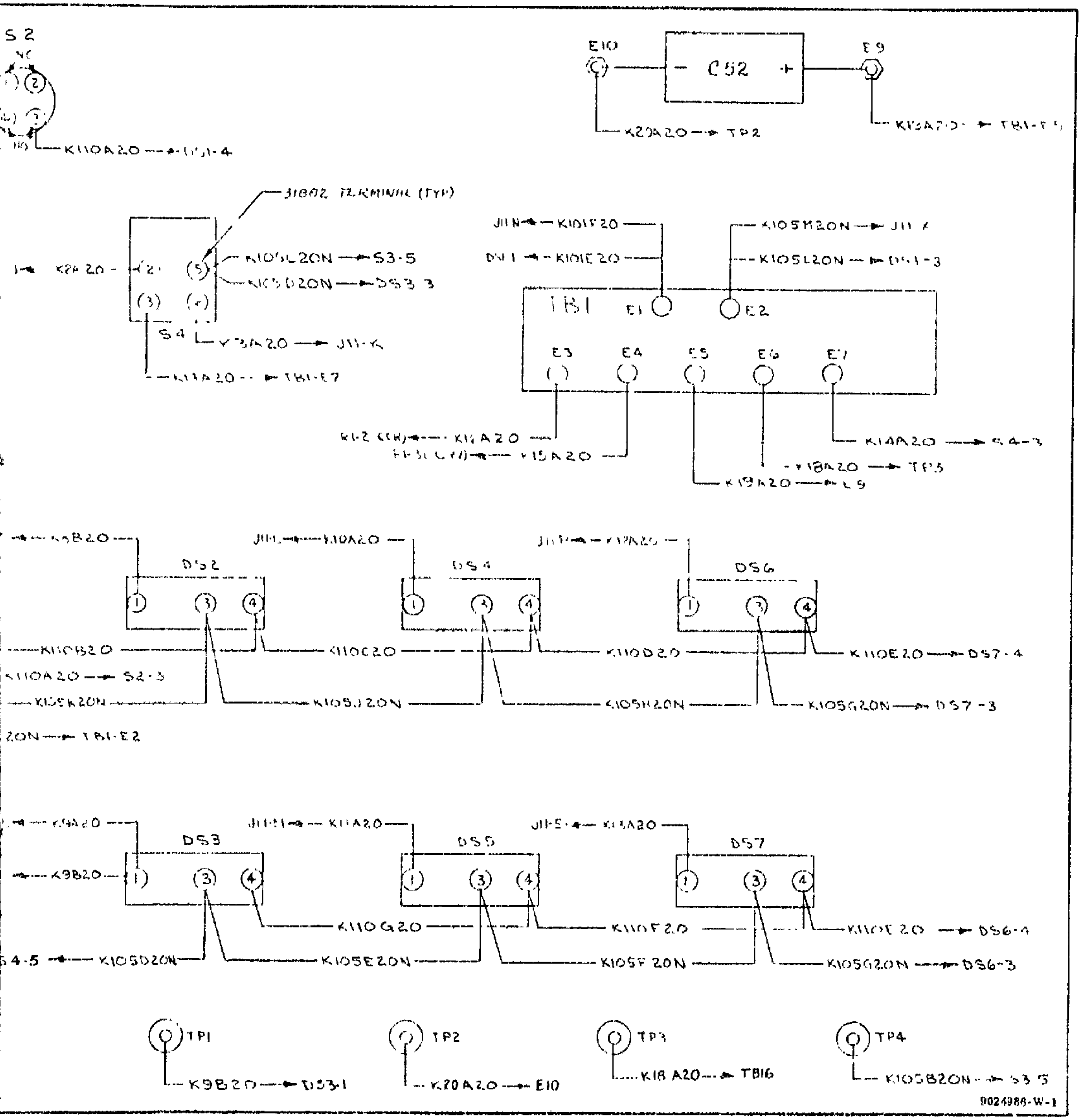


Figure 13-6. Vibration Safety Cutoff Test Panel Wiring Diagram


S2
C52
E10
E9
31802 TERMINAL (TYP)
TB1
E1
E2
E3
E4
E5
E6
E7
S4
DS2
DS3
DS4
DS5
DS6
DS7
K110A20 —→ S2-3
K110E20 —→ DS7-4
K105G20N —→ DS7-3
K110G20
K110F20
K105E20N
K105F20N
K105D20N
K105G20N —→ DS6-3
K110E20 —→ DS6-4
K14A20 —→ S4-3
K105J20N
K105H20N
K105K20N
TP1
TP2
TP3
TP4
K9B20 —→ DS3-1
K20A20 —→ E10
K18A20 —→ TB16
K105B20N —→ S3-5
9024986-W-1

13-16. REPAIRING WIRE HARNESS. See figure 13-5 for wire harness requirements and to ensure proper wire installation. No special instructions are required to repair the wire harness. Refer to paragraphs 13-11 and 13-12 for removing and installing wire harness. Perform function-test per paragraph 13-5.

13-17. REPAIRING TEST SET CASE. Repair of test set case consists of replacing clamps, nut plates, stud receptacles, and painting. Case components are listed in figure 13-1. Paint case exterior with gray paint 170-H-64 (W. P. Fuller Paint Co), or equivalent. Paint case interior with gray enamel (MIL-E-15090, Type III, Class 2) and bake for 30 minutes at 250° F. Allow one hour after baking for air drying. Bumper pads, handles, latches, clamp, pressure relief valve and rubber channel shall not be painted.

13-18. STORING VIBRATION SAFETY CUTOFF TEST SET COMPONENTS.

13-19. Prepare test set components for storage as follows:

a. Clean component. Refer to R-3825-5, Volume I.

b. Install protective caps on component receptacles.

c. Wrap component with greaseproof barrier material (MIL-B-121, Grade A) and seal.

d. Place wrapped component in a plastic bag and seal.

# SECTION XIV

## HOT-GAS TEMPERATURE TRANSDUCERS NA5-27323T4 AND NA5-27342T3

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14-1. DESCRIPTION AND LEADING PARTICULARS OF HOT-GAS RESISTANCE-TYPE TEMPERATURE TRANSDUCER NA5-27323T4.

14-2. The hot-gas resistance-type transducer (figure 14-1) is used to measure hot-gas temperature change by means of a resistance change. The temperature is determined by measuring the resistance of the wire-sensing element. The operating range of the transducer is from 0° to 1,800° F. The transducer consists of a wire-sensing element, mounted in a probe and protected by an insulator, and a receptacle. The receptacle is rated at 1,200° F continuous duty and mates with connector MS3106E-10SL-3S. The receptacle and the probe are welded into an integral hermetically sealed unit. Threads, size 7/16 - 20 UNF-3A, are provided on the housing of the transducer for installation. The transducer is 3.65 inches long and has a diameter of 0.88 inches with a probe reach of 1.60 inches.

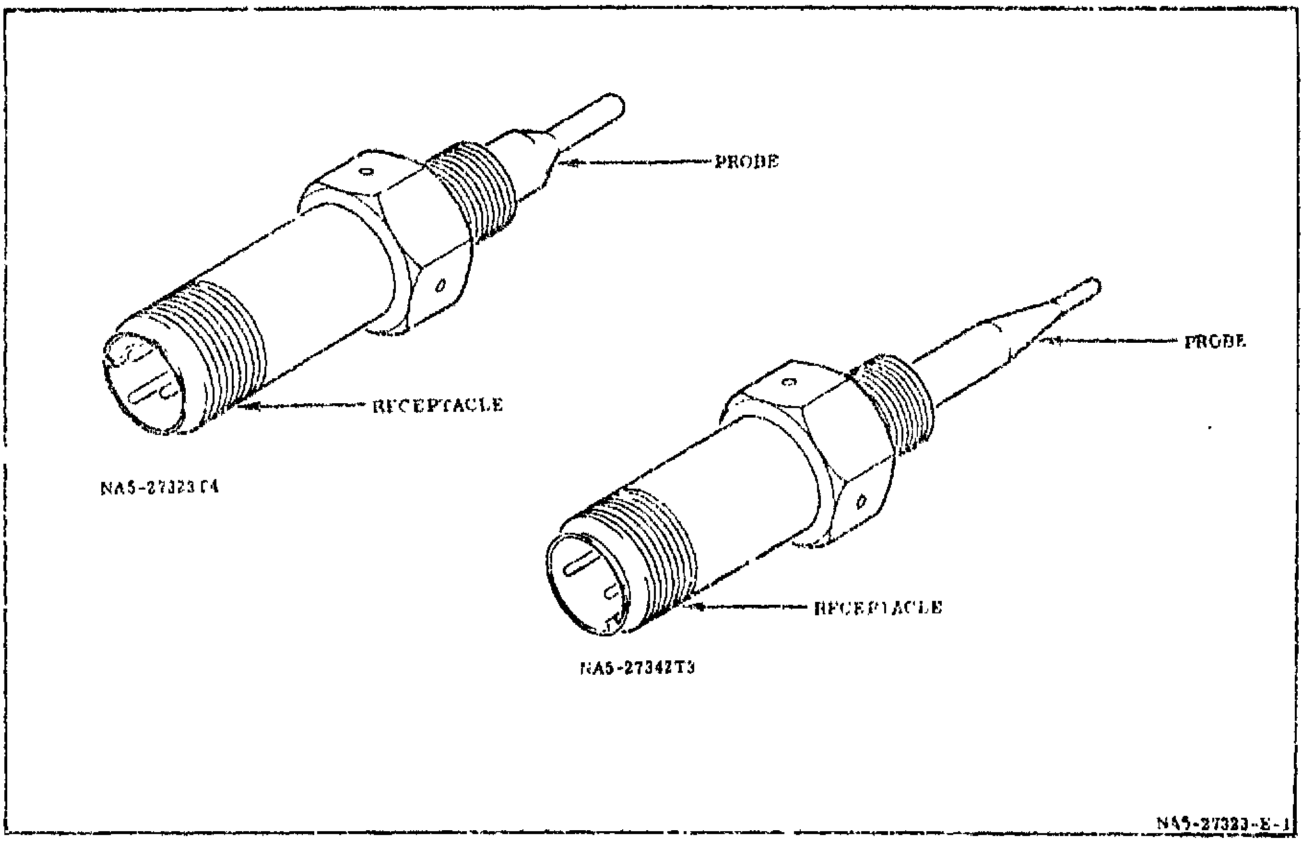


Figure 14-1. Hot-Gas Temperature Transducers

14-3. DESCRIPTION AND LEADING PARTICULARS OF HOT-GAS THERMOCOUPLE TEMPERATURE TRANSDUCER NA5-27342T3.

14-4. The hot-gas thermocouple transducer (figure 14-1) is used to measure hot-gas temperature in a 0° to 1,800° F range and to measure hot-gas temperatures where fast response to temperature variations is required. The transducer consists of an enclosed ground junction chromel-alumel sensor unit and a receptacle incorporated into a hermetically sealed integral unit. The sensor is enclosed in and attached to the probe and connected to the receptacle pins. The receptacle is rated at 1,000° F continuous duty and mates with connector SG3106E-10S1-53S (Bendix Corp). Threads size 7/16 - 20 UNF-3A, are provided on the transducer for installation. The transducer is 3.65 inches long and has a diameter of 0.88 inches with a probe reach of 1.90 inches.

14-5. MAINTENANCE OF HOT-GAS TEMPERATURE TRANSDUCERS.

14-6. The maintenance tasks required to ensure operation of the transducers are listed in figure 14-2. This figure lists the tasks to be performed, when the tasks shall be performed, and where the data support for these tasks will be found. The transducer is a replaceable item, therefore, no repairs are necessary.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect transducer for damaged threads on housing and receptacle | X | X | | | Replace transducer. |
| Inspect transducer probe and sealing surface for nicks, scratches, or finish defects | X | X | | | Replace transducer. |
| Inspect transducer probe for corrosion or dirt | X | X | | | Clean probe. Refer to Cleaning Electrical Components in section I. |
| Inspect transducer receptacle for absence of dust cap | X | X | | | Clean receptacle. Refer to Cleaning Electrical Components in section I. |
| Function-Test Hot-Gas Resistance-Type Transducer | | X | | X | Suspected malfunction. Refer to paragraph 14-7. |
| Function-Test Hot-Gas Thermocouple Temperature Transducer | | X | | X | Suspected malfunction. Refer to paragraph 14-9. |
| Clean transducer | | X | X | | Refer to Cleaning Electrical Components in section I. |
| Prepare transducers for storage | | | X | | Refer to paragraph 14-11. |

Figure 14-2. Maintenance Requirements for Hot-Gas Temperature Transducers

## 14-7. FUNCTION-TESTING HOT-GAS RESISTANCE-TYPE TEMPERATURE TRANSDUCER.

14-8. Function-testing of the transducer consists of a resistance check. The function-test may be performed with the transducer installed. See figure 14-3 for function-test and figure 14-5 for transducer wiring diagram. If results other than specified in test are obtained, the transducer shall be replaced.

| Step | Operation | Result |
|---|---|---|
| 1 | Obtain the following equipment:<br>Voltohmmeter, 2 milliampere maximum current.<br>Insulation resistance tester, 50 VDC maximum. | |
| CAUTION: The transducer shall be handled with extreme care to prevent possible damage to probe finish. | | |
| 2 | Remove protective cap from transducer receptacle. | |
| 3 | Measure resistance between the following:<br>(a) Pins A and B<br>(b) Pins A and C<br>(c) Pins B and C | <br>(a) 45-65 ohms.<br>(b) 45-65 ohms.<br>(c) Less than 2 ohms. |
| NOTE: Ensure the electrical receptacle is dry. | | |
| 4 | Apply 50 VDC between the following:<br>(a) Pin A to case<br>(b) Pin B to case<br>(c) Pin C to case | 100 megohms minimum. |
| 5 | Secure test equipment and transducer. Install protective cap on transducer receptacle. | |

Figure 14-3. Function-Testing Hot-Gas Resistance-Type Temperature Transducer

14-9. FUNCTION-TESTING HOT-GAS THERMOCOUPLE TEMPERATURE TRANSDUCER.

14-10. Function-testing of the transducer consists of a resistance test. The function-test may be performed with the transducer installed. See figure 14-4 for function-test and figure 14-5 for transducer wiring diagram. If results other than specified in the test are obtained, the transducer shall be replaced.

| Step | Operation | Result |
|---|---|---|
| 1 | Obtain voltohmmeter, 2 milliampere maximum current. | |
| CAUTION: | The transducer shall be handled with extreme care to prevent possible damage to probe finish. | |
| 2 | Remove protective cap from transducer receptacle. | |
| 3 | Measure resistance between pins A and B. | Less than 5 ohms. |
| 4 | Measure resistance between the following:<br>(a) Pin A and case<br>(b) Pin B and case | Less than 5 ohms. |
| 5 | Secure test equipment and transducer. Install protective cap on transducer receptacle. | |

Figure 14-4. Function-Testing Hot-Gas Thermocouple Temperature Transducers

## 14-11. STORING HOT-GAS TEMPERATURE TRANSDUCERS.

14-12. Prepare transducers for storage as follows:

a. Clean transducer. Refer to Cleaning Electrical Components in section I.

c. Install a protective shield over transducer probe.

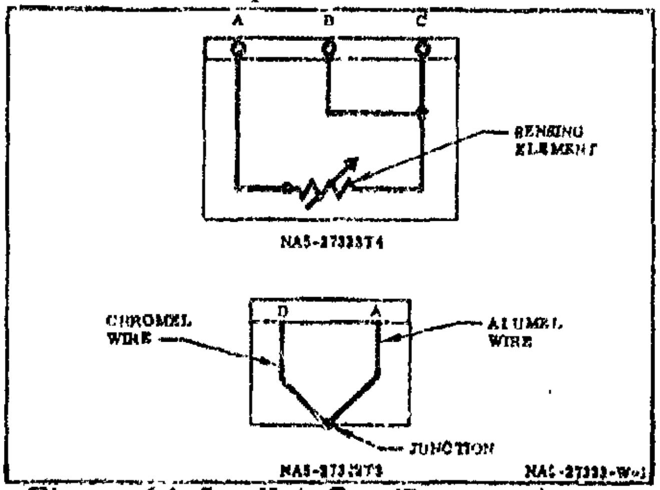


Figure 14-5. Hot-Gas Temperature Transducers Wiring Diagrams

d. Place transducer in a plastic bag and seal.

e. Package transducers separately in cushioned container.

# SECTION XV

# AMPLIFIER MOUNTING PANEL 9024500

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## 15-1. DESCRIPTION AND LEADING PARTICULARS OF AMPLIFIER MOUNTING PANEL.

15-2. The amplifier mounting panel (figure 15-1), is used as a mounting facility for the isolator amplifier of the extended range vibration safety cutoff test set. The amplifier mounting panel is a cabinet with provisions for mounting, operating, and calibrating 6 amplifiers. Each of the 6 amplifier positions has a coaxial connector, power supply, fuse, and external panel connectors. The external panel connectors are used for amplifier output, input, and calibration. Four of the amplifier positions have removable cover plates to cover the unused amplifier positions. A cooling blower and a 115 vac, 60-cycle external power cable are incorporated into the panel. The panel has mounting provisions for attachment to a standard rack and is 19.00 inches wide, 5.25 inches high and 17.25 inches deep. Amplifiers are installed into the mounting panel and mated with the coaxial connectors. Test facility output and input cables are attached to the external panel connectors. External power is supplied to the mounting panel which supplies power to the amplifiers and mounting panel blower for air circulation. Information relative to the use of the amplifier mounting panel can be found in Technical Manual R-3825-5, Volume I.

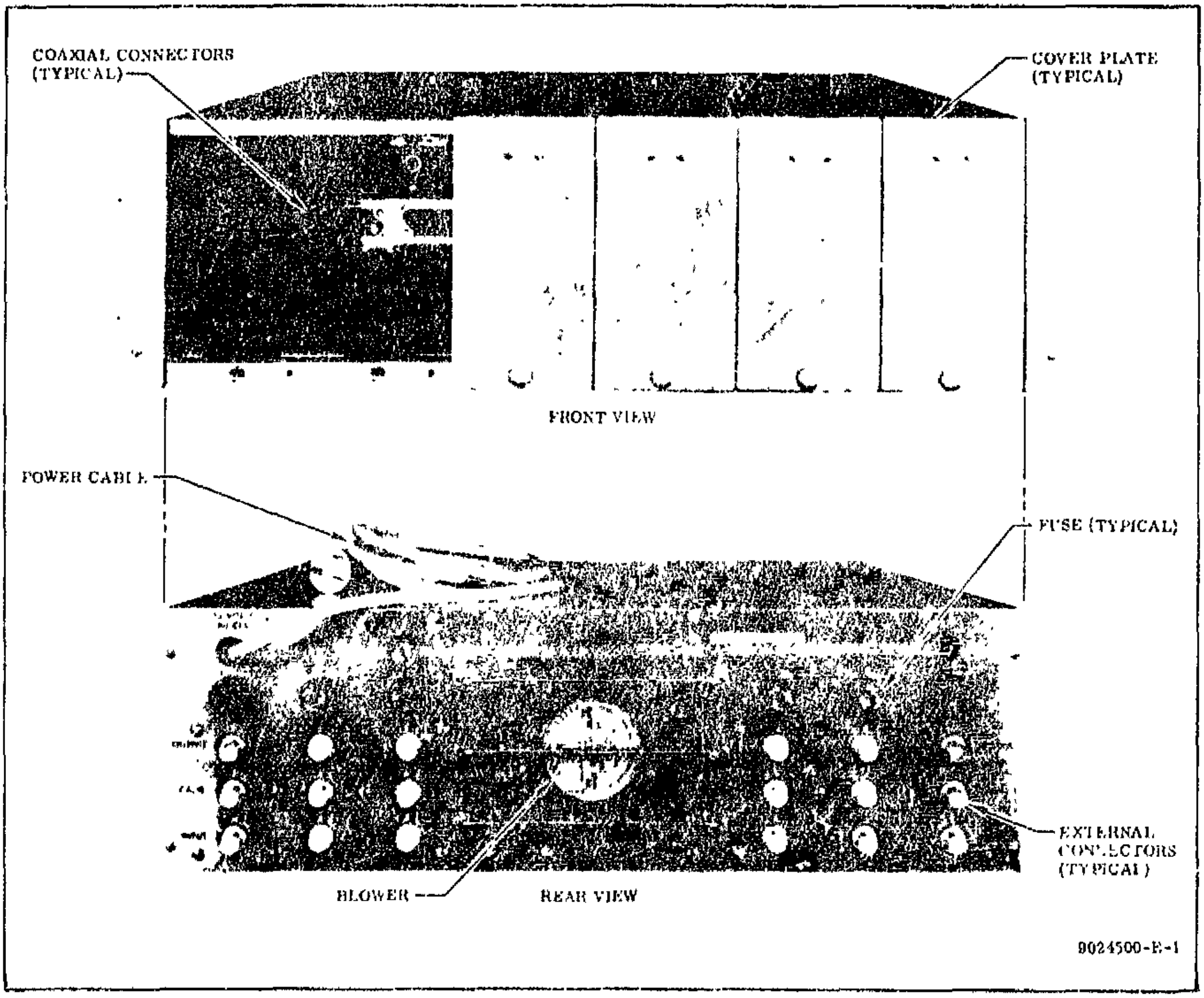


Figure 15-1. Amplifier Mounting Panel

## 15-3. MAINTENANCE OF AMPLIFIER MOUNTING PANEL.

15-4. Maintenance of the amplifier mounting panel consists of tasks required to ensure operation, and removing and replacing parts. Figure 15-2 lists the tasks to be performed, when the tasks shall be performed, and where the data support for these tasks will be found. No special instructions are required to remove and replace parts. Figure 15-1 and wiring diagram, figure 15-3, may be used to ensure proper installation of parts.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect panel for broken connector and insecurity of components. | X | X | | | Replace amplifier mounting panel. |
| Inspect for blown or damaged fuses. | X | X | | | Replace fuse. Use fuse 1/2 amp 3AG (Littlefuse Inc), or equivalent. |
| Inspect power cable for broken or frayed insulation. | X | X | | | Replace cable. Use three wire cable 18/35 VT (Lamcor Inc), or equivalent. |
| Inspect panel surfaces and electrical components for cleanness. | X | X | | | Clean. Refer to R-3825-5, Volume I. |
| Inspect blower for restricted movement. | | | | X | Weekly. Rotor must turn freely. If restricted, lubricate bearings with lubricating oil 19263-4 (Rotron, Inc), or equivalent. |
| Inspect mechanical alinement of coaxial connectors. | | | | X | Before installation of amplifier. Insert amplifier into connector. Replace panel if connectors are misalined. |
| Inspect for correct air circulation. | | X | | | With blower operating, verify air is flowing through front panel slots. |
| Prepare panel for storage. | | | X | | Refer to paragraph 15-7. |

Figure 15-2. Maintenance Requirements for Amplifier Mounting Panel

15-5. INSTALLING AMPLIFIER MOUNTING PANEL.

15-6. The panel is installed in a standard 19-inch rack in the instrumentation room of the engine test facility. No special instructions are required to install the panel. Refer to R-3825-5, Volume I for input and output cable requirements.

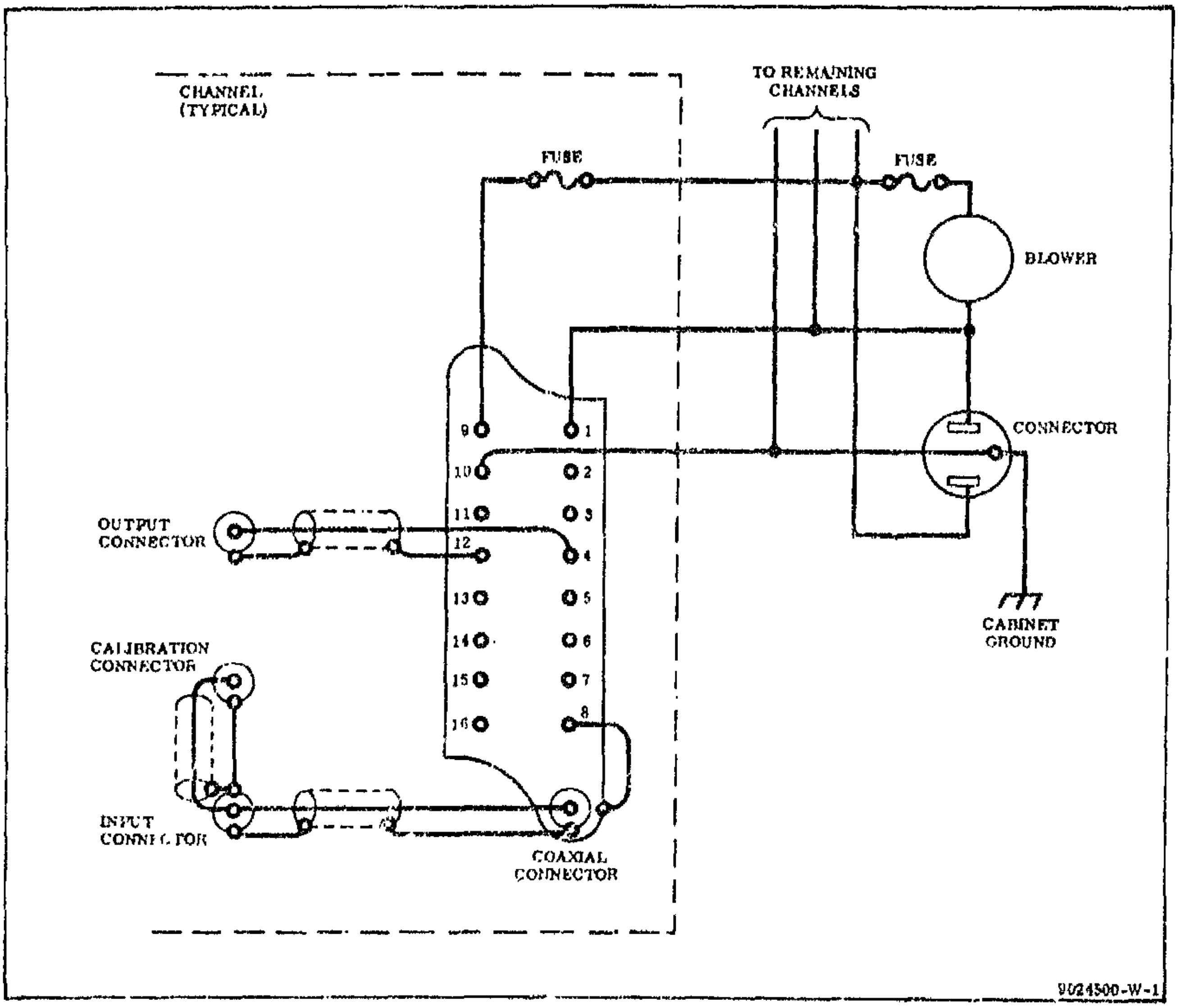


Figure 15-3. Amplifier Mounting Panel Wiring Schematic

15-7. STORING AMPLIFIER MOUNTING PANEL.

15-8. Prepare amplifier mounting panel for storage as follows:

a. Clean electrical components, panel interior and exterior surfaces, and cover plates. Refer to R-3825-5, Volume I.

b. Coil and secure power cable.

c. Install cover plates as required.

d. Wrap panel with greaseproof barrier material (MIL-B-121, Grade A) and seal.

## SECTION XVI

## THRUST CHAMBER DIFFUSER INSTALLING TOOL KIT 9025144

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### 16-1. DESCRIPTION AND LEADING PARTICULARS OF THRUST CHAMBER DIFFUSER INSTALLING TOOL KIT.

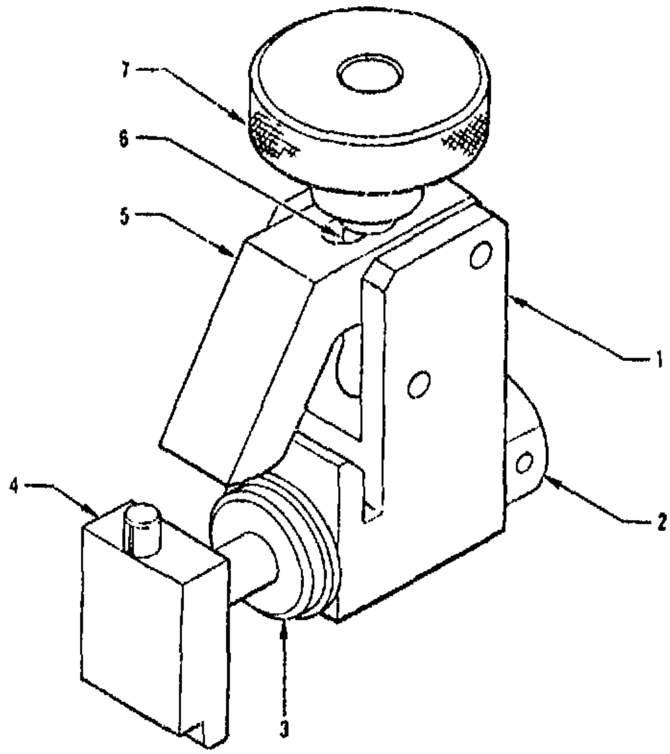
16-2. The tool kit (figure 16-1) contains 6 installing tools used to provide temporary attachment and alinement of the 6-inch film-cooled diffuser with the thrust chamber exit flange. The installing tool is a double clamp device consisting of a housing, adjusting knob, lever, clamp, eyebolt and sleeve incorporated into an integral tool. The lever, an angular shaped arm, is pinned to the housing at one end, providing a pivot point. A threaded eyebolt, pinned to the housing, extends through an elongated hole in the lever near the lever pivot point and has a knob attached to the threaded portion for lever adjustment. The clamp is a threaded shaft having a flat adapter at one end and is threaded into a sleeve which is held in the housing by a pinned adjusting nut. The moving parts of the installing tool are lubricated with dry lubricant. The 6 tools hold the diffuser, stiffener, and gaskets onto the exit flange of the thrust chamber with the engine in the vertical position and provide alinement of the holes so that the diffuser attaching hardware may be installed. The 6 installing tools are packaged in a reusable container. Instructions for the use of the thrust chamber diffuser installing tool kit are in R-3825-1B.

### 16-3. MAINTENANCE OF THRUST CHAMBER DIFFUSER INSTALLING TOOL KIT.

16-4. Maintenance tasks required on the tool kit are listed in figure 16-2. The information presented lists the tasks to be performed, when the tasks shall be performed, and where the data support for the tasks may be found. No special instructions are required to replace installing tool components. When replacing parts, see figure 16-1 for parts identification.

### 16-5. STORING THRUST CHAMBER DIFFUSER INSTALLING TOOL KIT.

16-6. Store and ship installing tools in reusable container provided with installing tool kit. See figure 16-1 for container identification. Clean installing tools prior to placing in container. Refer to R-3825-5, Volume I, for cleaning procedure.




| Index Number | Part Number | Nomenclature |
|---|---|---|
| | 9025144 | Thrust chamber diffuser installing tool kit |
| | 9026634 | Instruction decal |
| | 9026635 | Container |
| | 9026626 | Diffuser installing tool |
| 1 | 9026627 | Housing |
| 2 | 9026630 | Nut |
| | LD153-0011-0027 | Washer |
| | MS171684 | Pin |
| 3 | 9026628 | Sleeve |
| 4 | 9026629 | Clamp |
| 5 | 9026631 | Lever |
| | MS171656 | Pin |
| 6 | 9026633 | Bolt |
| | MS9245-24 | Pin |
| 7 | 9026632 | Knob |
| | AN950-5 | Socket washer |
| | AN995-5 | Ball washer |
| | LD153-0011-0017 | Washer |

Figure 16-1. Thrust Chamber Diffuser Installing Tool Kit

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect tool set and tools for completeness | X | X | | | See figure 16-1. |
| Inspect tool parts for galling, indicating dry-film lubricant worn from parts | X | X | | | Replace damaged part. See figure 16-1. |
| Inspect tool lever and adapter for restriction of movement | X | X | | | Replace damaged part. See figure 16-1. |
| Clean tools | | | X | | Refer to R-3825-5, Volume I, for cleaning procedure. |
| Prepare tools for storage | | | X | | Refer to paragraph 16-5. |

Figure 16-2. Maintenance Requirements for Thrust Chamber Diffuser Installing Tool Kit

# SECTION XVII

# PROOF-TEST WEIGHTS

WARNING

VERTICAL INSTALLER AND ENGINE SLING PROOF-TEST WEIGHTS 9025145 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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Underlined titles denote primary paragraphs.

## 17-1. DESCRIPTION AND LEADING PARTICULARS OF VERTICAL INSTALLER AND ENGINE SLING PROOF-TEST WEIGHTS 9025145.

17-2. The proof-test weight (figure 17-1) is used to proof-test the engine vertical installer, forward engine handling sling, and aft engine handling sling by subjecting the installer and slings to loads equal to twice their normal loads. The proof-test weight is comprised of an engine simulation proof-test weight, an engine sling proof-test weight, a hoist assembly, and turnbuckle assemblies. The engine simulation proof-test weight is a circular platform having a diameter equal to the engine exit flange, and a tubular retainer that contains the engine sling proof-test weight. Incorporated on the proof-test weight are adapters for sling and engine vertical installer cable fittings, retainers for stowage of the turnbuckles and hoist assembly, and provisions for forklift handling. The turnbuckle assemblies have concrete anchors that are permanently installed in the facility surface but allow the turnbuckles to be detached for storage. The hoist assembly contains two 8-inch pulleys and shackles for attaching to an overhead hoist. A removable proof-test weight stowed in the center retainer contains a lifting eye and an adapter for attaching the aft engine handling sling. An instruction plate illustrating the use of proof-test weight slings is mounted on the proof-test weight. The total weight of the vertical installer and engine slings proof-test weight (minus the hoist assembly and turnbuckles but including the 3,000-pound aft engine handling sling) is 7,600 ±50 pounds. When testing the engine vertical installer, the proof-test weight is placed on the installer rotating ring, the installer is anchored with the turnbuckles, and the hoist assembly is attached to an overhead hoist with the installer cables routed over the pulleys and attached to the proof-test weight. The installer hoists are operated and the weight lifted off of the installer. When testing the forward engine handling sling, the proof-test weights are lifted using the sling and an overhead hoist. Before testing the aft engine handling sling, the engine sling proof-test weight (1, figure 17-1) is separated from

the engine simulation proof-test weight (5, figure 17-1). The aft engine handling sling is then tested by lifting and suspending the engine sling proof-test weight with the aft engine handling sling and an overhead hoist. Information relative to the use of the proof-test weight is in section XVIII.

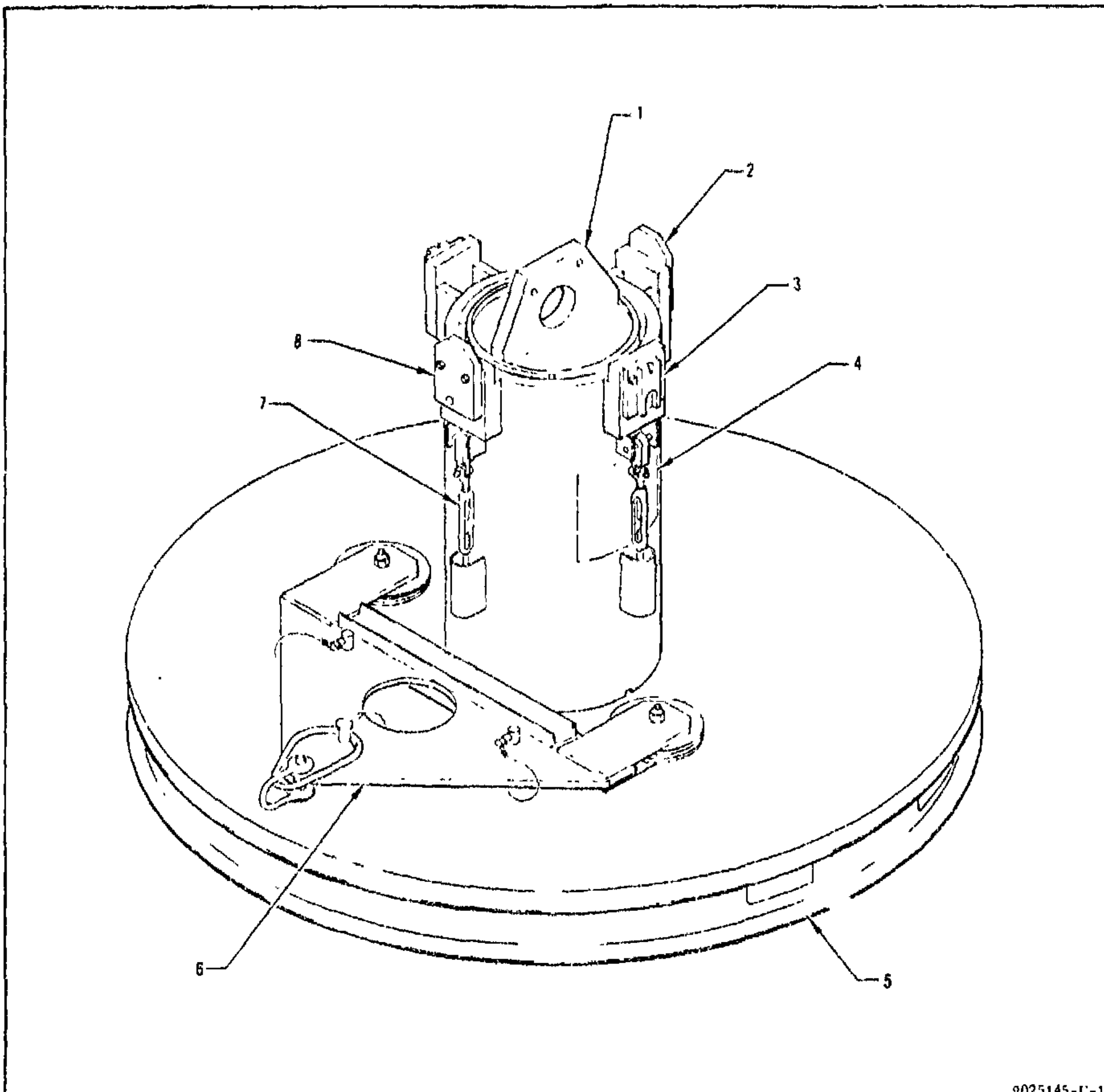


Figure 17-1. Vertical Installer and Engine Sling Proof-Test Weights (Sheet 1 of 2)

| Index No. | Part No. | Nomenclature | Source and Reliability Code (Refer to section I.) |
|---|---|---|---|
| | 9025145 | Vertical installer and engine sling proof-test weights | F1 |
| 1 | 9026681 | Engine sling proof-test weight | F3 |
| 2 | 9026689 | Adapter | F3 |
| | AN12-16A | Bolt | F3 |
| | MS35338-51 | Washer | F3 |
| 3 | 9026685 | Retainer | F3 |
| | AN12-16A | Bolt | F3 |
| | MS35338-51 | Washer | F3 |
| 4 | 9026693 | Instruction plate | F3 |
| 5 | 9026692 | Engine simulation proof weight | F3 |
| 6 | 9026679 | Hoist assembly | F1 |
| | 9026677 | Sling | F3 |
| | NAS1044-20 | Shackle | F3 |
| | MS20002-22 | Washer | F3 |
| | G341-1 3/8 | Ring | F3 |
| | 9026680 | Pulley | F3 |
| | 12705-16F-47S | Bolt | F3 |
| | LD153-0010-0028 | Washer | F3 |
| | LD153-0010-0024 | Washer | F3 |
| | RD114-8005-0012 | Nut | F3 |
| 7 | 9026684 | Turnbuckle assembly | F1 |
| | NAS1047-8-060 | Turnbuckle | F3 |
| | MS20392-5C49 | Pin | F3 |
| | MS24665-285 | Cotter Pin | F3 |
| | MS27183-14 | Washer | F3 |
| | 9026682 | Fitting | F3 |
| | BLDS-12-31 | Lockpin | F3 |
| | RD191-2001-2212 | Cable | F3 |
| | 28-2-G | Sleeve | F3 |
| | 9026683 | Anchor bolt | F3 |
| | 6855-1 | Anchor[a] | F3 |
| 8 | 9026687 | Adapter | F3 |
| | AN12-17A | Bolt | F3 |
| | MS35338-51 | Washer | F3 |

(a) Installed permanently in facility after initial use.

Figure 17-1. Vertical Installer and Engine Sling Proof-Test Weights (Sheet 2 of 2)

17-3. MAINTENANCE OF VERTICAL INSTALLER AND ENGINE SLING PROOF-TEST WEIGHTS.

17-4. Maintenance tasks required on the proof-test weight are listed in figure 17-2, which also indicates when the tasks must be performed and where the data support for the tasks may be found. When replacing parts, see figure 17-1 for part identification. Paint proof-test weight with orange-yellow enamel (Federal Specification TT-E-489); color 13538 (Federal Standard 595). Stencil markings with black enamel (MIL-E-5556); color 37038 (Federal Standard 595). When replacing the adapters and retainers, torque bolts to 1,200 in-lb. When installing pulley and bolt on hoist assembly, lubricate (Method W, R-3825-5, Volume 1) pulley hub and bolt bearing surfaces with Molykote G paste (Dow Corning Corp). No special procedures are required for storing the proof-test weights.

17-5. DESCRIPTION AND LEADING PARTICULARS OF TURBOPUMP SLING PROOF-TEST WEIGHT 9025146.

17-6. The proof-test weight (figure 17-3) is used to proof-test the turbopump sling and the oxidizer and fuel turbopump rotating sling by subjecting the slings to loads equal to twice their normal loads. The proof-test weight is a cube-shaped weight constructed so that the axis simulates the correct center of gravity of the turbopumps. Provisions on the weight are made for attaching the turbopump slings and for forklift handling. An instruction plate illustrating the use of the proof-test weight is attached to the weight. The proof-test weight weighs 850 ±15 pounds and is 28.00 inches long, 12.00 inches wide, and 20.12 inches high. The turbopump slings are attached to the proof-test weight and raised and suspended with an overhead hoist. When testing the oxidizer and fuel turbopump rotating sling, the weight is rotated from a vertical to a horizontal position while suspended. Information relative to the use of the turbopump sling proof-test weight is in section XIX.

17-7. DESCRIPTION AND LEADING PARTICULARS OF EXHAUST SYSTEM SLING PROOF-TEST WEIGHT 9025147.

17-8. The proof-test weight (figure 17-3) is used to proof-test the fuel turbine exhaust duct lifting sling by subjecting the sling to loads equal to twice the normal working load. The proof-test weight is a weighted cylinder with a rectangular plate intersecting the cylinder at two-thirds its height. A cutout has been provided on the rectangular plate to allow the sling to lift the weight at the proper angle to simulate the center of gravity of the duct. A band is painted on the weight to show sling attachment, and instructions are stenciled on the proof-test weight. The proof-test weight weighs 300 pounds and is 8 inches in diameter and 17 inches high, including the 12-inch square plate. The sling is attached to the proof-test weight and suspended with an overhead hoist. Information relative to the use of the exhaust system sling proof-test weight is in section IX.

17-9. DESCRIPTION AND LEADING PARTICULARS OF INLET DUCT SLING PROOF-TEST WEIGHT 9025148.

17-10. The proof-test weight (figure 17-3) is used to proof-test the propellant inlet duct sling by subjecting the sling to loads equal to twice the normal work loads. The proof-test weight weighs 381 ±12 pounds and is an 8-inch cylinder, 16 inches long, with 3 tubular bars used to attach the straps of the sling. Two of the tubular bars are attached at 5 degrees and 9 degrees in relation to the vertical center bar to maintain correct alinement with the sling straps. The sling is attached by looping the sling straps around the tubular bars and securing to the O-ring of each strap. The proof-test weight is suspended by the sling and an overhead hoist. Information relative to the use of the inlet duct sling proof-test weight is in section IX.

17-11. DESCRIPTION AND LEADING PARTICULARS OF START TANK SLING PROOF-TEST WEIGHT 9025149.

17-12. The proof-test weight (figure 17-3) is used to proof-test the start tank sling by subjecting the sling to loads equal to twice their normal loads. The proof-test weight is cone-shaped with three cutouts at the top of the weight to prevent damage to the lifting sling straps during proof tests. Forklift provisions are incorporated on the weight. An attach point identification band and stenciled instructions

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect proof-test weight for completeness. | X | X | | | See figure 17-1. |
| Inspect turnbuckles for restricted operation. | X | X | | | Replace restricted turnbuckles. See figure 17-1. |
| Inspect pulleys for smooth operation. | X | X | | | Replace defective pulleys. See figure 17-1. Refer to paragraph 17-3. |
| Inspect lockpins for operation. | X | X | | | Replace inoperative lockpin. See figure 17-1. |
| Inspect for frayed or broken cables. | X | X | | | Replace damaged cable. See figure 17-1. |
| Inspect instruction plate for obliterated instructions. | X | X | | | Replace obliterated instruction plate. See figure 17-1. |
| Lubricate hoist assembly. | | | | X | Every 90 days. Refer to paragraph 17-3. |
| Clean proof-test weight. | X | X | | | Refer to R-3825-5, Volume I. |

Figure 17-2. Maintenance Requirements for Vertical Installer and Engine Sling Proof-Test Weights

show sling attachment and lifting procedures. The proof-test weight weighs 250 ±8 pounds and is 28.5 inches in diameter and 15.5 inches high. During proof testing of the start tank sling, the sling is attached to the proof-test weight and suspended with an overhead hoist. Instructions for the use of the start tank sling proof-test weight are in section IX.

17-13. <u>MAINTENANCE OF TURBOPUMP AND COMPONENTS SLING PROOF-TEST WEIGHTS.</u>

17-14. Maintenance of the proof-test weights consists of painting, stenciling, and cleaning. Replace instruction plate 9025143 on turbopump proof-test weight when obliterated or damaged. Paint proof-test weights with orange-yellow enamel (Federal Specification TT-E-489), color 13538 (Federal Standard 595). Stencil markings and paint band on the proof-test weight with black camouflage enamel (MIL-E-5556); color 37038 (Federal Standard 595). Hand-wipe proof-test weight. Refer to R-3825-5, Volume I. No special procedures are required for storing the proof-test weights.

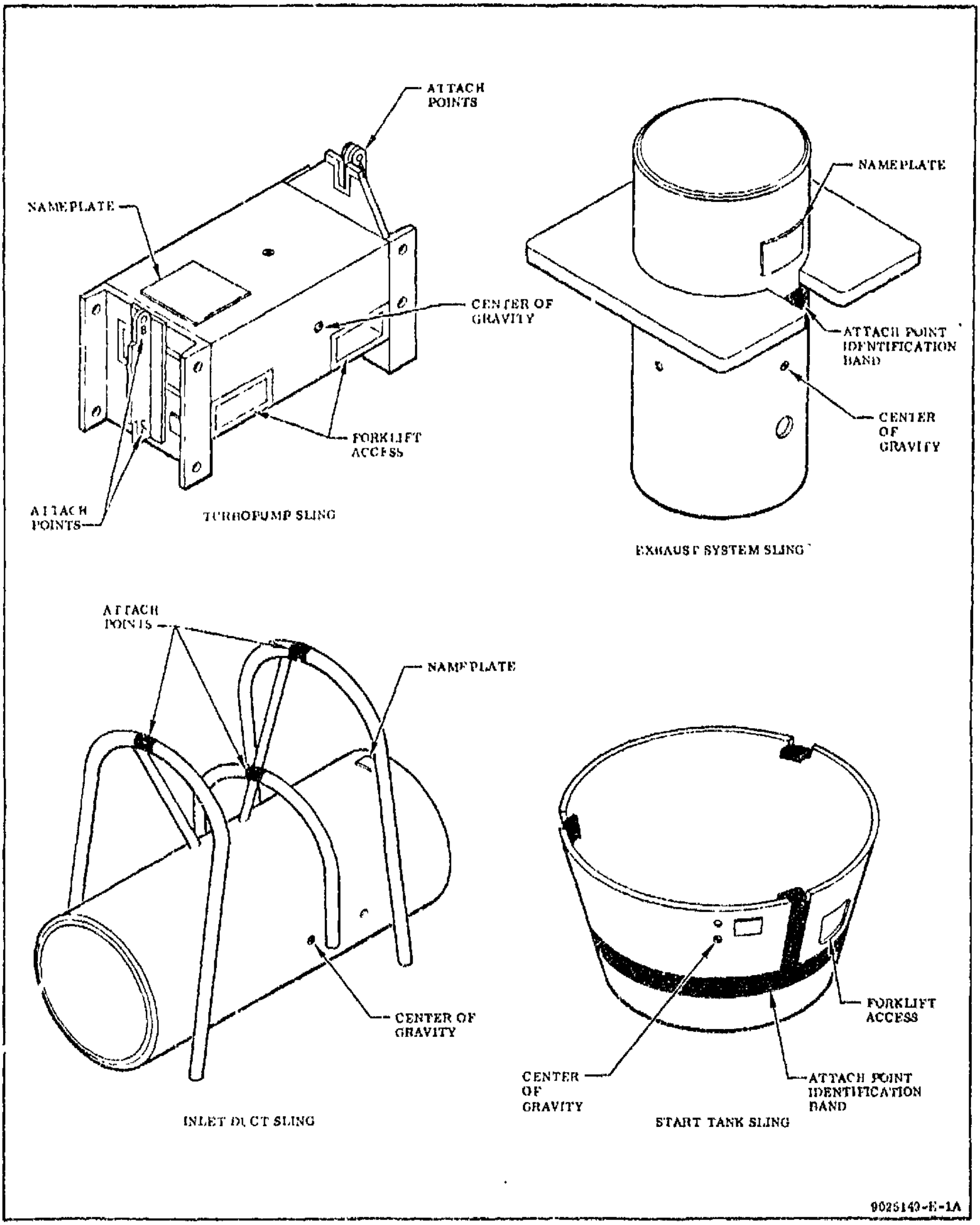


Figure 17-3. Sling Proof-Test Weights

Pages 17-7 and 17-8 deleted.

# SECTION XVIII

# ENGINE HANDLING SLINGS

WARNING

FORWARD ENGINE HANDLING SLING G4042 AND AFT ENGINE HANDLING SLING G4045 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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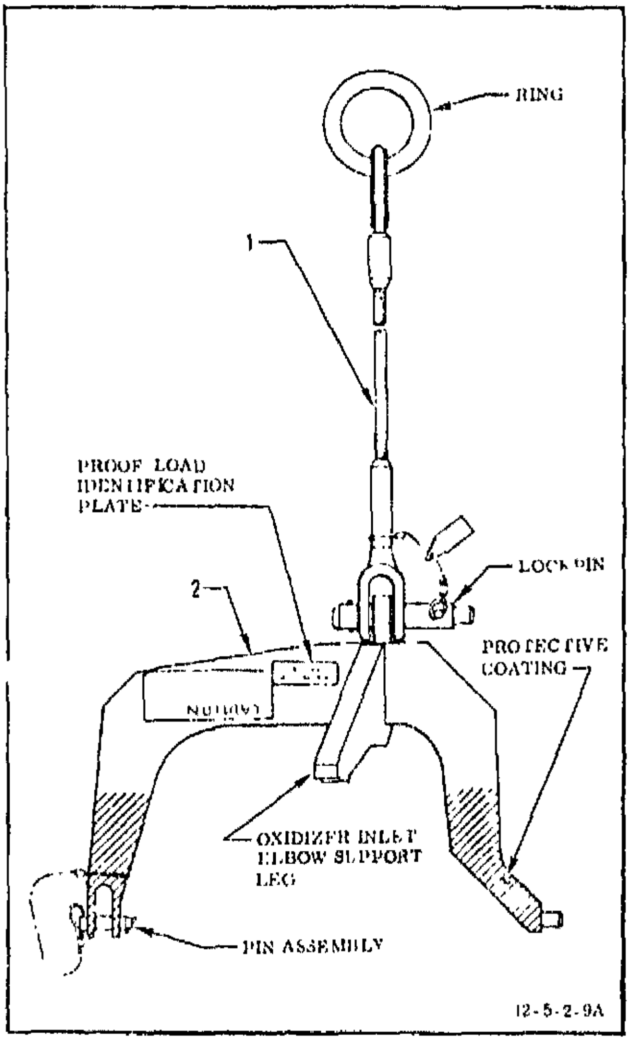
## 18-1. DESCRIPTION AND LEADING PARTICULARS OF FORWARD ENGINE HANDLING SLING G4042MD1.

18-2. The forward engine handling sling (figure 18-1) is used to lift the engine in its vertical position or is used in conjunction with the aft engine handling sling and 2 hoists to rotate the engine from or to a horizontal position. The forward engine handling sling consists of sling 9018245-11 and adapter 9018243-11. The sling consists of a 22-inch-long protective-coated cable, a 5-inch-diameter ring, and a tethered lockpin for attaching the sling to the adapter. The adapter consists of a protective-coated tripod-type frame and a tethered pin assembly for safe attachment to the engine. The oxidizer inlet elbow support leg of the adapter bears against the inlet elbow flange to provide stability during both horizontal and vertical engine hoisting. The forward engine handling sling weighs approximately 60 pounds, has a working load of 3,680 pounds, and is proof tested to 7,600 pounds. To lift and/or rotate an engine, the sling is attached at the forward end of the engine to adapters on the fuel side and oxidizer side according to instructions contained in R-3825-3.

## 18-3. DESCRIPTION AND LEADING PARTICULARS OF AFT ENGINE HANDLING SLING G4045.

18-4. The aft engine handling sling (figure 18-2) is used in conjunction with the forward engine handling sling and 2 hoists to lift the engine in a horizontal position or to rotate the engine to or from a vertical position. The aft engine handling sling consists of a sling 9018241, yoke 9018242, and 2 tethered quick-release pins NAS1339S3C28D. The sling consists of a 5-inch-diameter ring, a 108-inch protective-coated cable, and a shackle with pin and cotter pin. The aft engine handling sling has a working load of 1,000 pounds and is proof tested to 3,000 pounds. The sling is secured to a lifting lug located on the aft end of the engine. Information relative to the use of the aft engine handling sling is in R-3825-3.




| Index Number | Part Number | Nomenclature |
|---|---|---|
| | G4042MD1 | Forward engine Handling sling |
| 1 | 9018245-11 | Sling |
| | BLC20GT27 | Pin |
| | RD191-2002-1216 | Wire rope (cable) |
| | 28-1C | Sleeve |
| | RD171-1032-0001 | Proof load Identification plate |
| | RD171-6018-0001 | Identification plate |
| | 9022075 | Plate |
| 2 | 9018243-11 | Adapter |
| | 9024302 | Pin assembly |
| | RD191-2002-1214 | Wire rope (cable) |
| | 28-1C | Sleeve |
| | RD171-1032-0001 | Proof load Identification plate |
| | 9024306 | Identification plate |

Figure 18-1. Forward Engine Handling Sling G4042MD1

## 18-5. CONFIGURATION CHANGES--MANUAL EFFECTIVITY.

18-6. Modifications incorporated in this manual that change the configuration of the engine handling slings are listed in figure 18-3. Specifically, Forward Engine Handling Sling G4042 became Forward Engine Handling Sling G4042MD1 by replacing sling 9018245 with sling 9018245-11, replacing adapter 9018243 with adapter 9018243-11, and deleting bolt AN10-17, nut AN121558, washer LD153-0010-0022, cotter pin MS24665-375, and lockpins LW3S-LB. 878.

## 18-7. MAINTENANCE OF ENGINE HANDLING SLINGS.

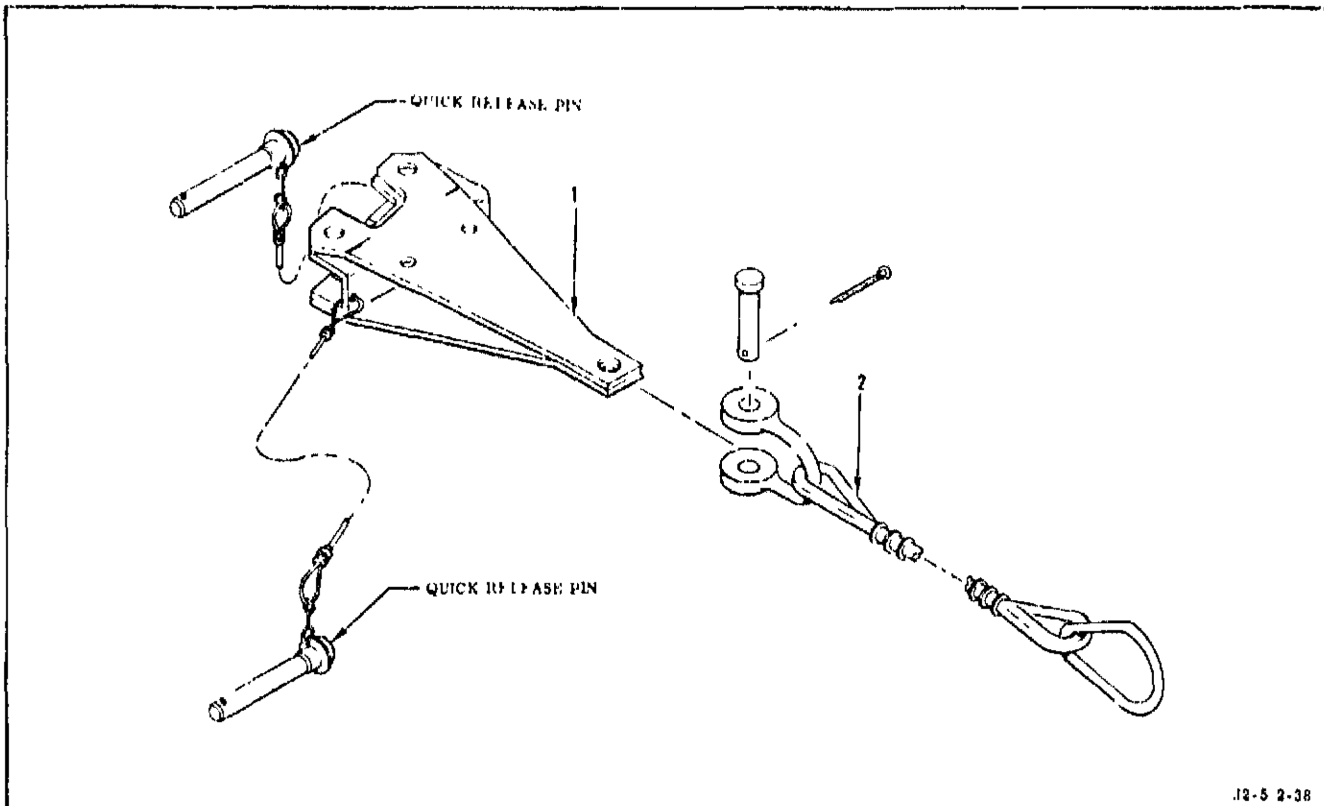
18-8. Maintenance tasks required on the slings are listed in figure 18-4, which also indicates when the tasks are to be performed and provides paragraph references necessary to accomplish these tasks. No special procedures are necessary to replace the sling component parts or to store the slings.

18-9. PROOF-TESTING FORWARD ENGINE HANDLING SLING. Proof-testing the sling is accomplished by lifting and suspending the vertical installer and engine slings proof-test weight 9025145 with the sling. Perform proof test as follows:

NOTE

The proof-test weight weighs 7,600 pounds without the hoist assembly or turnbuckles attached.

a. Remove hoist assembly and turnbuckles from proof-test weight, and attach sling to adapters on proof-test weight. Refer to TEST NO. 2 on proof-test weight instruction plate.




| Index Number | Part Number | Nomenclature | Index Number | Part Number | Nomenclature |
|---|---|---|---|---|---|
| | G4045 | Aft engine handling sling | 1 (Cont) | RD171-1032-0001 | Proof load Identification plate |
| 1 | 9018242 | Yoke | | RD171-6016-0001 | Identification plate |
| | NAS1339S3C28D | Quick-release pin | | | |
| | RD191-2002-1314 | Wire rope (cable) | | | |
| | 28-2-G | Sleeve | 2 | 9018241 | Sling |

Figure 18-2. Aft Engine Handling Sling G4045

| Approved ECP No. | MD No. | Incorporated in Manual Dated |
|---|---|---|
| J2-644 | 1 | 17 November 1969 |

Figure 18-3. Configuration Changes--Manual Effectivity

WARNING

In the following procedure, the hoisted test weight causes extreme strain on the sling. Accelerating, jerking, or traversing the proof-test weight during test can cause possible failure of the sling resulting in serious injury to personnel and damage to equipment.

b. Lift test weight approximately 6 inches, and suspend test weight for 5 minutes.

c. Record proof test. A proof-load identification plate RD171-1032-0001 may be used to record date and verification of proof test.

**18-10. PROOF-TESTING AFT ENGINE HANDLING SLING.** Proof-testing the sling consists of lifting and suspending aft sling proof-test weight 9026681 with the sling. Perform proof test as follows:

NOTE

The aft sling proof-test weight weighs 3,000 pounds.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect sling for completeness. | X | X | | | Refer to paragraph 18-1 or 18-3. |
| Inspect lockpins for restricted movement. | X | X | | | Lubricate lockpin. Refer to R-3825-5, Volume I, for lubricating procedures. If restriction is not eliminated, replace lockpins. |
| Inspect adapter of G4042MD1 for absence of protective coating. (See figure 18-1.) | X | X | | | Repair coating. Refer to R-3825-5, Volume I. |
| Inspect cables for: | | | | | |
| Absence of protective coating | X | X | | | Replace damaged cable. |
| Frayed or broken wire strands | X | X | | | Replace damaged cable. |
| Inspect yoke and hoisting sling for: | | | | | |
| Elongated or misalined lockpin holes | X | X | | | Replace damaged component. |
| Cracked welds | X | X | | | Replace damaged component. |
| Obliterated identification plates | X | X | | | Replace identification plate. |
| Clean engine handling slings. | | | | X | Handwipe surfaces to maintain level of cleanness. Refer to R-3825-5, Volume I. |
| Proof-test forward engine handling sling. | | | | X | Every 6 months. Refer to paragraph 18-9. |
| Proof-test aft engine handling slings. | | | | X | Every 6 months. Refer to paragraph 18-10. |

Figure 18-4. Maintenance Requirements for Engine Handling Slings

a. Remove aft sling proof-test weight from vertical installer and engine slings proof-test weight.

b. Attach aft engine handling sling to aft sling proof-test weight. Refer to TEST NO. 3 on vertical installer and engine slings proof-test weight instruction plate.

WARNING

In the following procedure, the hoisted test weight causes extreme strain on the sling. Accelerating, jerking, or traversing the proof-test weight during the test can cause possible failure of the sling resulting in serious injury to personnel and damage to equipment.

c. Lift test weight approximately 6 inches and suspend test weight for 5 minutes.

d. Record proof test. A proof-test identification plate RD171-1032-0001 may be used to record date and verification of proof test.

## 18-11. PAINTING ENGINE HANDLING SLINGS.

WARNING

The following specifies primer (MIL-P-8585), which is flammable and must not be used near heat, sparks, or open flame. It is toxic. Inhalation of its vapors or prolonged contact with the primer can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

Paint exposed or scratched surfaces of engine handling slings with zinc chromate primer (MIL-P-8585) and a finish coat of orange-yellow enamel (MIL-E-7729), color 13538 (Federal Standard 595).

# SECTION XIX

# TURBOPUMP SLING

WARNING

TURBOPUMP SLING G4046 AND OXIDIZER AND FUEL TURBOPUMP ROTATING SLING G4063 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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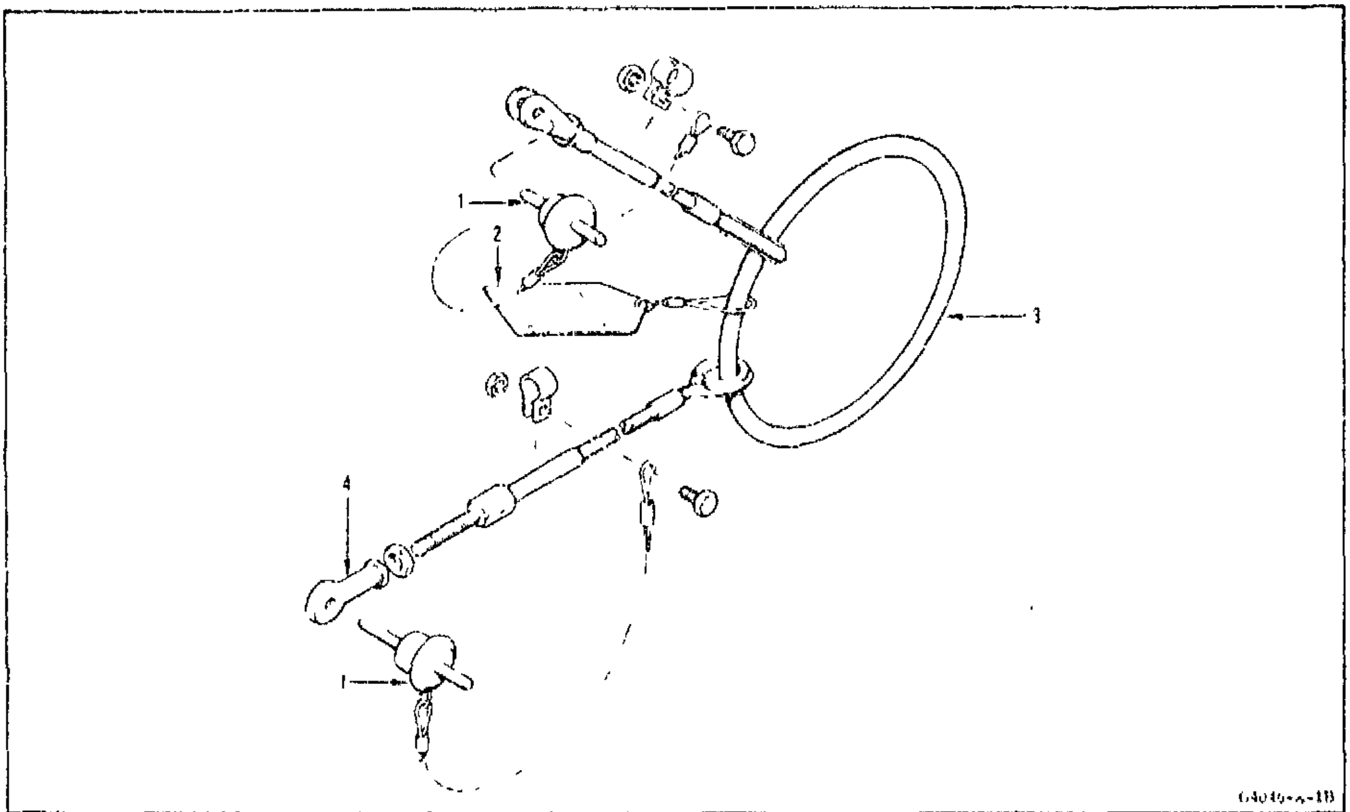
Underlined titles denote primary paragraphs.

## 19-1. DESCRIPTION AND LEADING PARTICULARS OF TURBOPUMP SLING G4046.

19-2. The turbopump sling (figure 19-1) is used for handling the fuel and oxidizer turbopumps with or without the bipod mounts attached to the turbopumps. The sling consists of two protective-coated cables 23.75 and 30.00 inches long, attached to a 5-inch-diameter hoisting ring. The two cable ends are equipped with fittings for attachment to the inlet end and exhaust end of the turbopump. The fitting attached to the exhaust-end cable of the sling is a threaded rod-end bearing with a locknut that permits adjustment of the sling. The inlet-end cable of the sling is fitted with a clevis. Quick-release lockpins are used with both fittings. The sling has a working load of 425 pounds and is proof tested to 850 pounds. The sling is attached to the fuel or oxidizer turbopump and is operated in conjunction with an overhead hoist.

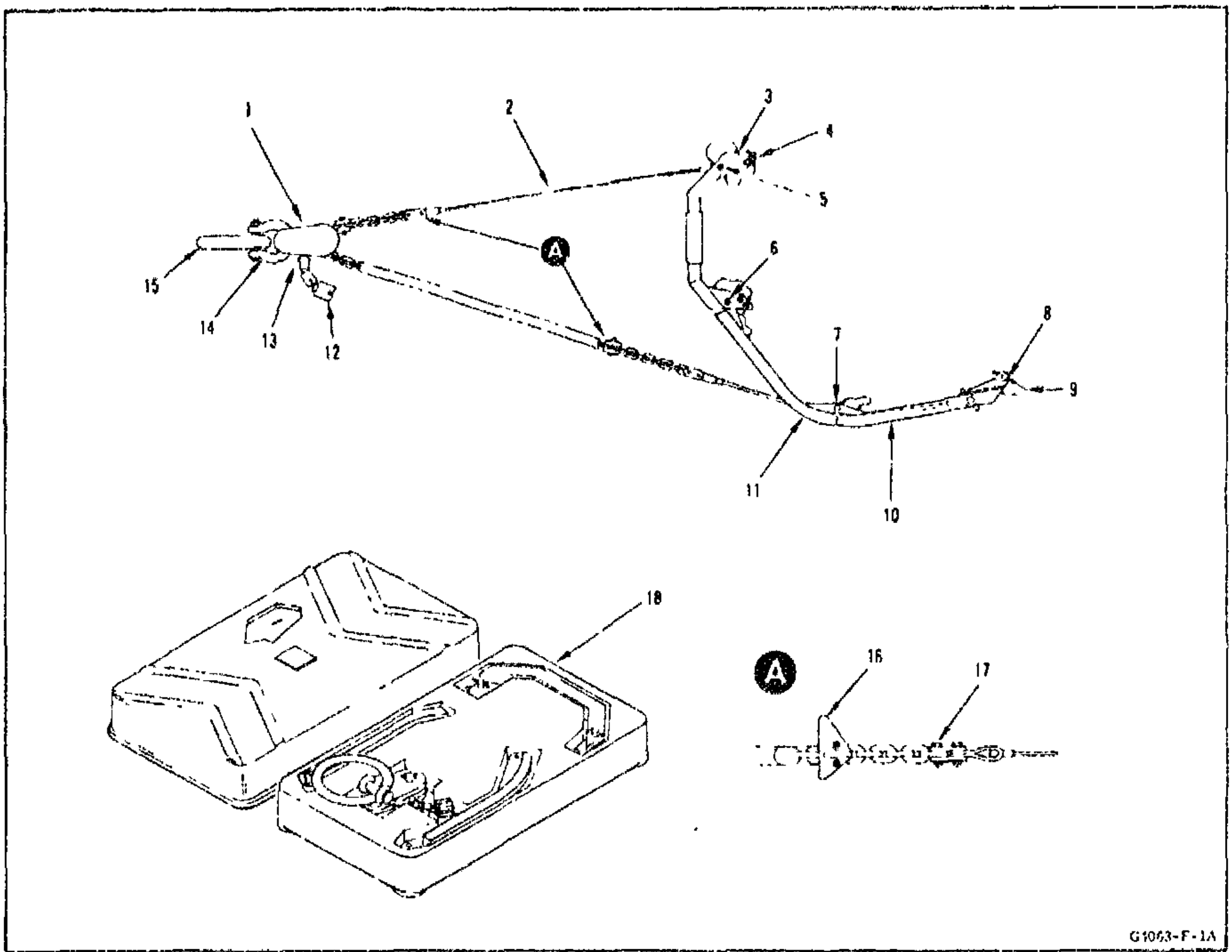
## 19-3. DESCRIPTION AND LEADING PARTICULARS OF OXIDIZER AND FUEL TURBOPUMP ROTATING SLING G4063.

19-4. The turbopump rotating sling (figure 19-2) is used with an overhead hoist to rotate the oxidizer and fuel turbopumps from a horizontal to a vertical position or from a vertical to a horizontal position during engine disassembly and assembly. The sling assembly has a load path rotation of 100 degrees, including a variable of 10 degrees beyond the normal horizontal and vertical turbopump positions. The rotating sling consists of a self-locking worm gear rotating drive unit and a chain with a protective-coated steel cable on each end connected to a frame. The drive unit is equipped with a universal joint to accommodate a 0.5-inch drive wrench as a rotating crank, a 5-inch diameter hoisting ring, and a shackle. The chain is routed through the worm gear rotating mechanism of the drive unit, providing the rotational travel of the sling. The frame is comprised of a three-piece jointed assembly equipped with quick-release lockpins for assembling and connecting the frame to the sling cables. Quick-release lockpins provide means of attaching the frame to either the oxidizer or fuel turbopump end closure adapters. The sling has a working load of 425 pounds and is proof tested to 850 pounds. When handling the turbopump, the sling frame is attached to the turbopump adapters, and rotation of the turbopump is accomplished by rotating a wrench connected to the drive unit. As the wrench rotates the worm gear of the drive unit, the chain is pulled through and the frame rotates. The drive unit is self-locking and, unless operated, will retain the turbopump in any position between horizontal and vertical. The frame compensates for the difference in lengths and shapes of the fuel and oxidizer pumps and controls the center of gravity during rotation.




| Index No. | Part No. | Nomenclature | Index No. | Part No. | Nomenclature |
|---|---|---|---|---|---|
| | G4046 | Turbopump Sling | 2 | RD171-4006-0002 | Sling proof-test tag |
| 1 | NAS1334C3C08 | Lockpin | | RD171-6013-0002 | Identification plate |
| | AN3-3A | Bolt | | RD191-2001-2208 | Cable |
| | AN735-4 | Clamp | 3 | 9018247 | Sling |
| | NAS679C3W | Nut | 4 | HFX-4FG | Rod end |
| | RD191-2002-1310 | Cable | | RD114-1005-0001 | Nut |
| | 28-2-G | Sleeve | | | |

Figure 19-1. Turbopump Sling




| Index No. | Part No. | Nomenclature |
|---|---|---|
| | G4063 | Oxidizer and Fuel Turbopump Rotating Sling |
| | 9023422 | Rotating sling |
| 1 | 253LH-CV | Drive unit and chain |
| 2 | 9022080 | Cable |
| 3 | 9022079 | Bracket |
| | RD171-1032-0001 | Proof-load identification plate |
| 4 | NAS1334A2C1.2D | Quick-release pin |
| 5 | NAS1336A2C1.4D | Quick-release pin |
| 6 | NAS1336A2C1.2 | Quick-release pin |

| Index No. | Part No. | Nomenclature |
|---|---|---|
| 7 | NAS1336A2C1.2D | Quick-release pin |
| 8 | NAS1336A2C0.9D | Quick-release pin |
| 9 | RD191-2002-4306 | Cable |
| | 28-2-G | Sleeve |
| 10 | 9021069 | Link |
| 11 | 9021066 | Center link |
| 12 | IMB-8 | Universal joint |
| 13 | 9022063 | Joint |
| | LD153-0011-0008 | Washer |
| | MS20392-1C27 | Pin |
| | MS24665 | Cotter pin |

Figure 19-2. Oxidizer and Fuel Turbopump Rotating Sling (Sheet 1 of 2)

| Index No. | Part No. | Nomenclature | Index No. | Part No. | Nomenclature |
|---|---|---|---|---|---|
| 14 | NAS1042-12 | Shackle | 17 | 9023421 | Strap |
| | | | | NAS1305H-12 | Bolt |
| 15 | S-643,7/8xf.5ID | Ring | | NAS679A5 | Nut |
| | | | | LD153-0010-0012 | Washer |
| 16 | 9022138 | Stop | | | |
| | AN4-13A | Bolt | 18 | G4063-3 | Container |
| | LD153-0010-0009 | Washer | | | |
| | NAS679A4W | Nut | | | |

Figure 19-2. Oxidizer and Fuel Turbopump Rotating Sling (Sheet 2 of 2)

19-5. MAINTENANCE OF TURBOPUMP SLINGS.

19-6. Maintenance tasks required on the turbopump slings are listed in figure 19-3, which also indicates when the tasks are to be performed and where the data support for the tasks may be found. When replacing parts, see figure 19-1 or 19-2 for parts identification. The only special maintenance requirements consist of lubricating, torquing, and painting the oxidizer and fuel turbopump rotating sling. Lubricate (Method W, R-3825-5, Volume I) the drive unit with Molykote G paste (Dow Corning Corp). When replacing stop or strap, torque stop attaching nuts to 27-35 in-lb, and strap attaching nuts to 71-90 in-lb. Paint drive unit, frame assembly, stop, and strap with orange-yellow enamel (Federal Specification TT-E-489); color 13538 (Federal Standard 595).

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect slings for completeness. | X | X | | | See figures 19-1 and 19-2. |
| Inspect sling quick-release lockpins for restricted operation. | X | X | | | Replace inoperative pins. See figure 19-1 or 19-2. |
| Inspect slings for absence of protective coating. | X | X | | | Replace damaged slings or cable. See figure 19-1 or 19-2. |
| Inspect slings for frayed or broken cables. | X | X | | | Replace damaged sling or cable. See figure 19-1 or 19-2. |
| Inspect rotating sling for bent links. | X | X | | | Replace chain. See figure 19-2. |
| Inspect rotating sling chain for safety stops. | X | X | | | Replace safety stops. See figure 19-2. |
| Inspect rotating sling frame assembly for distorted links or bent brackets. | X | X | | | Replace damaged link. See figure 19-2. |

Figure 19-3. Maintenance Requirements for Turbopump Slings (Sheet 1 of 2)

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Lubricate rotating sling drive unit. | | | | X | Every 6 months. Refer to paragraph 19-5. |
| Proof-test turbopump sling. | | | | X | Every 6 months. Refer to paragraph 19-7. |
| Proof-test rotating sling. | | | | X | Every 6 months. Refer to paragraph 19-9. |
| Clean turbopump slings. | | | X | | Refer to Cleaning External Surfaces of Equipment, R-3825-5, Volume I. |
| Prepare turbopump slings for storage. | | | X | | Refer to paragraph 19-11. |

Figure 19-3. Maintenance Requirements for Turbopump Slings (Sheet 2 of 2)

19-7. PROOF-TESTING TURBOPUMP SLING.

19-8. Proof-testing of the turbopump sling consists of lifting and suspending turbopump sling proof-test weight 9025146 with the sling. Proof-test sling as follows:

a. Attach turbopump sling to proof-test weight by attaching short cable to attach point A and long cable to attach point B. (See TEST NO. 2 on turbopump proof-test weight instruction plate.) The hoisting ring must be directly above the center-of-gravity reference point.

WARNING

The hoisted test weight causes extreme strain on the sling. Accelerating, jerking, or traversing the proof-test weight during lifting, lowering, or while suspended can cause undue strain and possible failure of the sling resulting in serious injury to personnel and damage to equipment.

b. Lift proof-test weight 6 inches and suspend for 5 minutes.

c. Inspect sling components for deformation or damage upon completion of proof test.

d. Record proof-test data. A proof-load identification plate (figure 19-1) may be used to record date and verification of proof test.

19-9. PROOF-TESTING OXIDIZER AND FUEL TURBOPUMP ROTATING SLING.

19-10. Proof-testing the rotating sling consists of lifting, suspending, and rotating turbopump sling proof-test weight 9025146 with the sling. To proof-test the sling, proceed as follows:

a. Attach rotating sling (figure 19-4) to adapters on proof-test weight. (See TEST NO. 1 on proof-test weight instruction plate.)

WARNING

The hoisted test weight causes extreme strain on the sling. Accelerating, jerking, or traversing the proof-test weight during lifting, lowering, or while suspended can cause undue strain and possible failure of the sling resulting in serious injury to personnel and damage to equipment.

b. Lift proof-test weight and suspend for 5 minutes. The centerline of proof-test weight must be 10 ±5 degrees below horizontal. (See figure 19-4.)

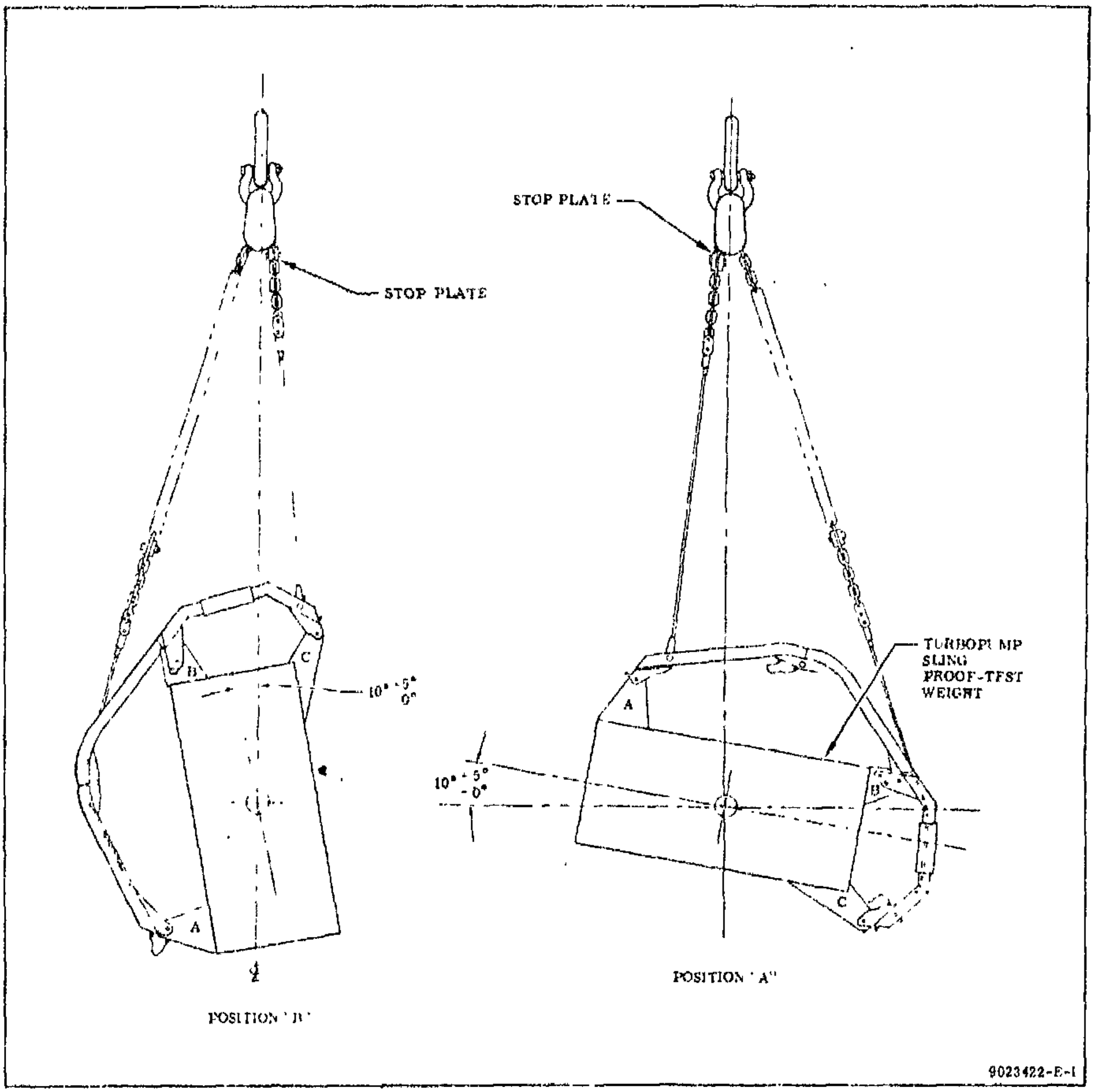



Figure 19-4. Proof-Testing Oxidizer and Fuel Turbopump Rotating Sling

c. Rotate sling, with proof-test weight suspended, to opposite stop. The proof-test weight must not reverse the rotating sling at any position. The proof-test weight centerline must be 10 ±5 degrees past the vertical centerline of the sling drive unit. (See figure 19-4.) Suspend for 5 minutes.

d. Inspect rotating sling and component parts for structural integrity, deformation, or damage.

e. Record proof-test data. A proof-load identification plate (figure 19-2) may be used to record date and verification of proof test.

19-11. STORING TURBOPUMP SLINGS.

19-12. To prepare turbopump slings for storage, proceed as follows:

a. Clean slings. (Refer to figure 19-3.)

b. Remove frame assembly on rotating sling from sling and disassemble frame assembly. Place rotating sling in container. See figure 19-2 for parts replacement and container identification.

c. Apply a smooth, even coat of corrosion preventative RB0210-016 (Rocketdyne), or equivalent, on rod end, threads, and clevis of turbopump sling.

# SECTION XX

# PROPELLANT INLET DUCT NULL ADJUSTER SET 9024540

WARNING

PROPELLANT INLET DUCT NULL ADJUSTER SET 9024540 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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## 20-1. DESCRIPTION AND LEADING PARTICULARS OF PROPELLANT INLET DUCT NULL ADJUSTER SET.

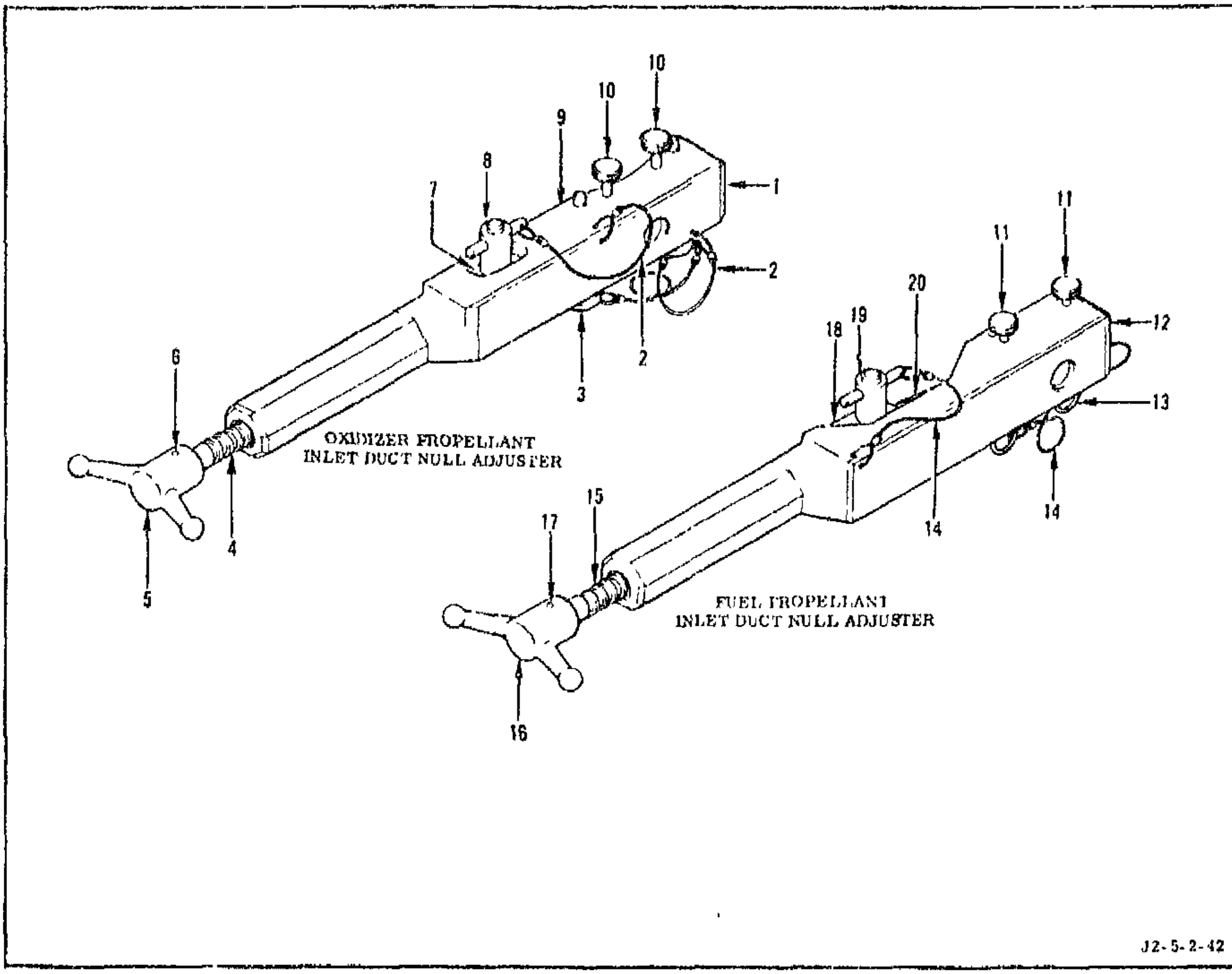
20-2. The null adjuster set is used to adjust the propellant inlet duct tension bellows to a null position. The set contains 2 tools, one for the oxidizer propellant inlet duct and one for the fuel propellant inlet duct, and spare shear pins. The tools and shear pins are packaged in reusable containers. Instructions for the use of the tools are in R-3825-3.

## 20-3. DESCRIPTION OF OXIDIZER AND FUEL INLET DUCT NULL ADJUSTERS.

20-4. The oxidizer and fuel null adjusters are similar except the housing and idlers are shaped differently and the handles are color-coded to identify their respective ducts. Null adjusters are comprised of a housing, a screw assembly, and pins to attach the tool to the duct. A sight hole in the tool enables the user to see alinement marks during duct adjustment. The housing is internally threaded at one end and contains attach pins and thumbscrews, a clevis, and an idler. Two threaded areas on the screw assembly are used to provide mechanical leverage: one set engaging the housing and the other engaging the clevis. A color-coded handle associating the tool with system use is pinned to the screw assembly with a shear pin. Spare shear pins are included in the null adjuster set. Ball-lock pins attached to the housing by retaining cables attach the idler to the clevis and the null adjusting tool to the duct. Thumbscrews incorporated in the housing position the idler to engage one of the center flanges of the duct. Null adjusters are 25.5 inches long and weigh 15 pounds. The null adjuster is attached to the center flanges of the duct: the idler to one center flange and the housing to the other. As the screw assembly is turned, the idler rotates the flange while the opposite flange is held stationary by the null adjuster housing. The screw assembly is turned until index marks are alined within specified tolerance, as through the sight hole in the null adjusting tool. Null adjusters can be used on a duct installed or removed from the engine and with the engine in either vertical or horizontal position. Null adjusters are capable of rotating duct flanges from the extreme out-of-null position of ±2.3 degrees to the null position, with an accuracy of ±0.1 degrees.

## 20-5. MAINTENANCE OF PROPELLANT INLET DUCT NULL ADJUSTER SET.

20-6. Maintenance tasks required for operation of the null adjuster set are listed in figure 20-2, which lists the tasks to be performed and where data support for these tasks will be found. See figure 20-1 for part replacement identification. The only special maintenance requirements consist of lubricating and installing shear pins. Lubricate (Method C, R-3825-5, Volume I) threads of the screw assembly with Fluorolube grease GR-362 (Hooker Chemical Corp). Peen both ends of the shear pin when installing handle to screw assembly.




| Index Number | Part Number | Nomenclature |
|---|---|---|
| | 9024540 | Propellant inlet duct null adjuster set |
| | VD192-0007-0024 | Container |
| | 9024771 | Shear pin (6 required) |
| | 9024757 | Oxidizer propellant inlet duct null adjuster |
| 1 | 9024763 | Housing |
| 2 | RD191-2002-1112 | Cable |
| | 28-1-C | Sleeving |
| 3 | BLDS5-20S | Ball-lock pin |
| 4 | 9024766 | Screw |
| 5 | 9024772-3 | Handle |
| 6 | 9024771 | Shear pin |
| 7 | 9024765 | Clevis |
| 8 | BLS8GT11F | Ball-lock pin |
| 9 | 9024769 | Idler |
| 10 | 9024770 | Thumbscrew |
| | 9024767 | Fuel propellant inlet duct null adjuster |

Figure 20-1. Propellant Inlet Duct Null Adjuster Set (Sheet 1 of 2)

| Index Number | Part Number | Nomenclature |
|---|---|---|
| 11 | 9024770 | Thumbscrew |
| 12 | 9024768 | Housing |
| 13 | BLDS5-20 | Ball-lock pin |
| 14 | RD191-5002-1112 | Cable |
| | 28-1C | Sleeve |
| 15 | 9024766 | Screw |
| 16 | 9024772-5 | Handle |
| 17 | 9024771 | Shear pin |
| 18 | 9024765 | Clevis |
| 19 | BLS8GT11F | Ball-lock pin |
| 20 | 9024764 | Idler |

Figure 20-1. Propellant Inlet Duct Null Adjuster Set (Sheet 2 of 2)

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect null adjuster set for completeness. | X | X | | | See figure 20-1. |
| Inspect ball-lock pins for operation. | X | X | | | Replace inoperative pins. See figure 20-1. |
| Inspect null adjusters for nicks, scratches, and burs. | X | X | | | Replace damaged parts. See figure 20-1. |
| Inspect thumbscrews for damaged threads. | X | X | | | Replace damaged thumbscrews. See figure 20-1. |
| Inspect null adjuster screw assembly, clevis, and housing for galling indicating dry-film lubricant worn from threads. | X | X | | | Replace galled parts. See figure 20-1. |
| Inspect for frayed or broken cables. | X | X | | | Replace damaged cables. See figure 20-1. |
| Inspect handle for damaged protective coating. | X | X | | | Replace damaged handle. See figure 20-1. |
| Inspect screw assembly and handle for broken shear pins. | X | X | | | Replace shear pins. Refer to paragraph 20-5. |
| Clean null adjuster. | | | X | | Refer to R-3825-5, Volume I, for cleaning procedure. |
| Lubricate null adjuster. | | | | X | Every six months. Refer to paragraph 20-5. |
| Prepare null adjuster for storage. | | | X | | Refer to paragraph 20-7. |

Figure 20-2. Maintenance Requirements for Propellant Inlet Duct Null Adjuster Set

20-7. STORING PROPELLANT INLET DUCT NULL ADJUSTER SET.

20-8. Clean null adjusters to prepare the set for storage. Refer to R-3825-5, Volume I, for cleaning procedure. Package shear pins in container RX19110-2 or a 0.004-inch-thick polyethylene bag (commercial). Package null adjusters and container of shear pins in null adjuster set container VD192-0007-0024.

Pages 20-5 and 20-6 deleted.

# SECTION XXI

# INLET DUCT SUPPORT FRAME INSTALLING TOOL KIT 9025150

WARNING

INLET DUCT SUPPORT FRAME INSTALLING TOOL KIT 9025150 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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Underlined titles denote primary paragraphs.

## 21-1. DESCRIPTION AND LEADING PARTICULARS OF INLET DUCT SUPPORT FRAME INSTALLING TOOL KIT.

21-2. The installing tool kit (figure 21-1) aids installation of support frames and consists of 3 installing tools stored in a reusable container. The installing tools are turnbuckles, with attaching jaws on either end, held by retaining pins which also limit travel of the jaws and prevent unnecessary removal or loss. Two holes in the turnbuckle barrel, closed with removable plugs, permit removal of the jaw retaining pins. The installing tools are attached to the inlet duct bipods, one turnbuckle on each pair. Rotation of the knurled turnbuckle barrel compresses or extends the inlet duct to permit installation of the support frames. The turnbuckles have a nominal total adjustable range of 4.44 inches. Instructions for the use of the tool kit are in R-3825-13 and R-3825-3.

## 21-3. MAINTENANCE OF INLET DUCT SUPPORT FRAME INSTALLING TOOL KIT.

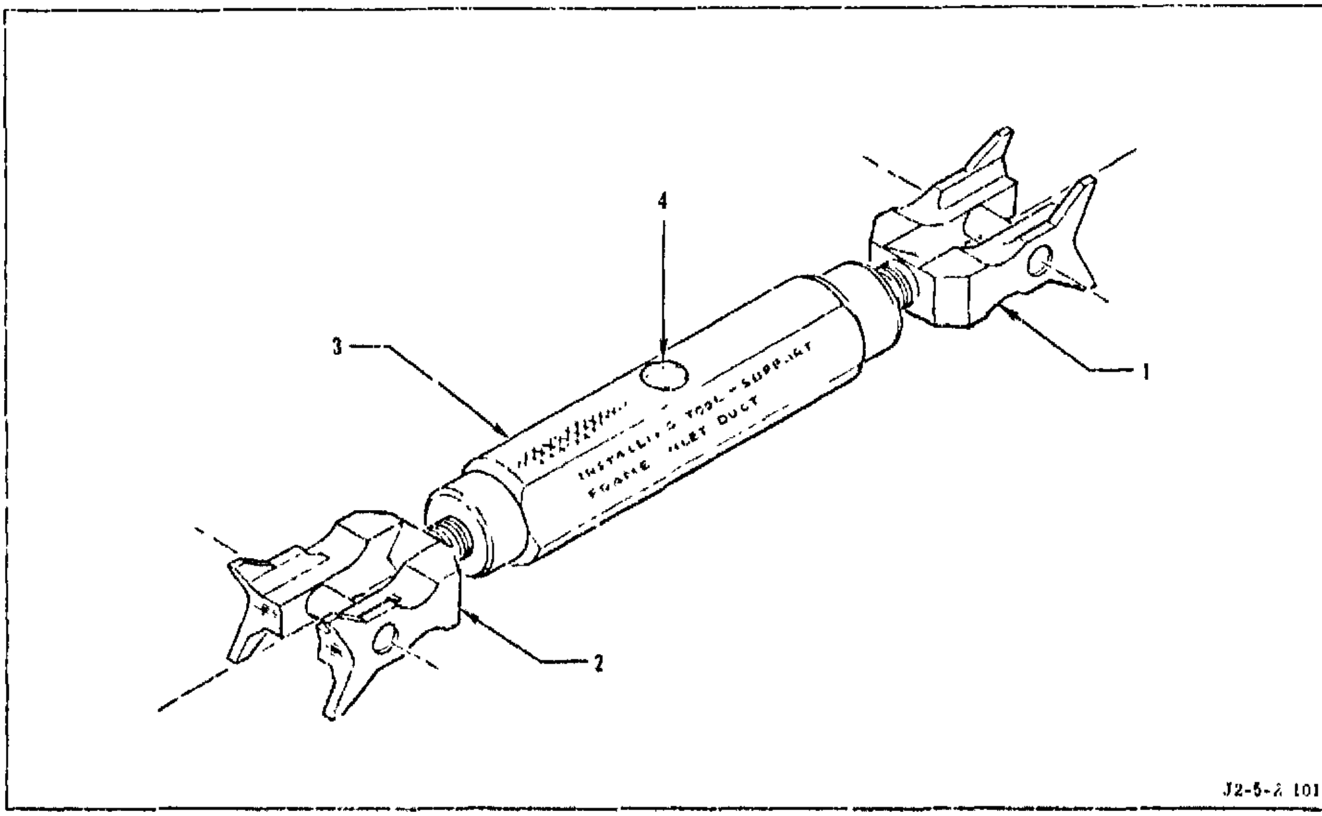
WARNING

The following specifies primer (MIL-P-8585), which is flammable and must not be used near heat, sparks, or open flame. It is toxic. Inhalation of its vapors or prolonged contact with the primer can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

21-4. Maintenance tasks required on the tool kit are listed in figure 21-2. The information presented lists the tasks to be performed, when the tasks must be performed, and where data support for the tasks is found. See figure 21-1 for part replacement identification. Maintenance instructions consist of priming turnbuckle ends with zinc chromate primer (MIL-P-8585) and painting turnbuckle barrel ends with red enamel (MIL-E-5556); color 31136 (Federal Standard 595).

## 21-5. STORING INLET DUCT SUPPORT FRAME INSTALLING TOOL KIT.

21-6. Store or ship inlet duct support frame installing tools in reusable container provided with tool kit. See figure 21-1 for container identification.




| Index No. | Part No. | Nomenclature |
|---|---|---|
| | 9025150 | Inlet Duct Support Frame Installing Tool Kit |
| | 9026639 | Container |
| | 9026636 | Installing Tool |
| 1 | 9026638 | Attaching Jaw |
| 2 | 9026638-11 | Attaching Jaw |
| | MS171528 | Retaining Pin |
| 3 | 9026637 | Turnbuckle Barrel |
| 4 | SS-48192K1110 | Plug |

Figure 21-1. Inlet Duct Support Frame Installing Tool Kit

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect tool kit for completeness. | X | X | | | See figure 21-1. |
| Insp t installing tool jaw threads for galling indl . ng dry-film lubricant worn from parts. | X | X | | | Replace galled parts. See figure 21-1. |
| Inspect turnbuckle barrel ends for absence of paint. | X | X | | | Paint turnbuckle barrel ends. Refer to paragraph 21-3. |
| Inspect turnbuckle for absence of plugs. | X | X | | | Replace missing plugs. See figure 21-1. |
| Clean tools. | | X | X | | Refer to R-3825-5, Volume I. |
| Prepare tools for storage. | | | X | | Refer to paragraph 21-5. |

Figure 21-2. Maintenance Requirements for Inlet Duct Support Frame Installing Tool Kit

# SECTION XXII

# ENGINE HANDLER G4064

WARNING

ENGINE HANDLER G4064 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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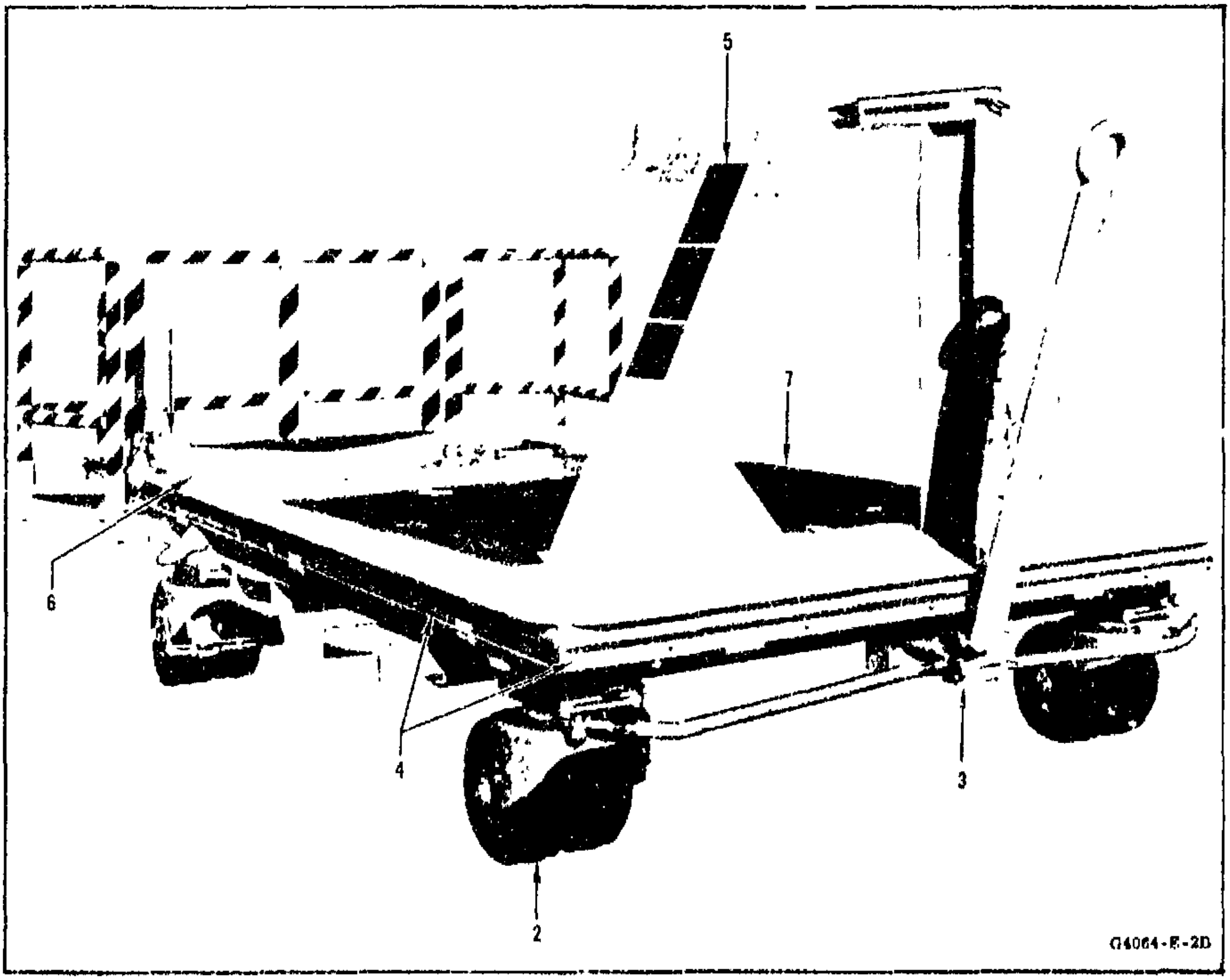
PARAGRAPH — PAGE



## 22-1. DESCRIPTION AND LEADING PARTICULARS OF ENGINE HANDLER.

22-2. The engine handler (figure 22-1) is used to support the J-2 engine during shipping, maintenance, and storage, and to transport the engine within a facility. The handler consists of a rectangular frame assembly incorporating two vertical struts and a detachable yoke for supporting the engine, four caster assemblies, a steering assembly, a handler dust cover, and an engine cover assembly incorporating an engine cover and an engine dust cover. The two vertical struts located at the forward end of the handler support the forward end of the engine. The yoke located at the aft end of the handler is provided with swiveling, ball-joint attach fittings, allowing the engine to move as a unit and preventing damage to engine attach lugs. The yoke is attached to the engine with quick-disconnect pins. The swiveling permanently-lubricated casters have dual wheels with pneumatic tires, parking brakes, and position locks on the rear casters. The steering assembly consists of a detachable tow bar and a tongue with tie rods connecting the front casters. A minimum turning radius of 115 inches must not be exceeded when towing the engine handler, or damage to the tow bar or steering assembly will result. The tow bar has a lock enabling it to be stored in a vertical position. The tie rods are adjustable, enabling the front casters to be properly alined. Maximum towing speed is 5 miles per hour. A safety chain must be used between handler and towing vehicle. Two channels attached to the underside of the handler frame provide fork-lift handling access. Compartments located in the handler frame provide storage space for the engine cover assembly and handler dust cover. The compartments are




| Index Number | Nomenclature |
|---|---|
| | Engine Handler G4064 |
| 1 | Container |
| 2 | Caster (Typical) |
| | Swivel Lock Assembly (Rear Only) |
| | Spacer |
| | Tire |
| | Tube |
| 3 | Steering Gear Assembly |
| | Tie Rod |

Figure 22-1. Engine Handler (Sheet 1 of 2)

| Index Number | Nomenclature |
|---|---|
| 3 (Cont) | Tongue |
| | Tow Bar Assembly |
| | Pin |
| | Latch |
| | Bar |
| 4 | Retainer (Typical) |
| 5 | Instruction Plate (Typical) |
| 6 | Yoke |
| 7 | Deck Assembly (Typical) |

Figure 22-1. Engine Handler (Sheet 2 of 2)

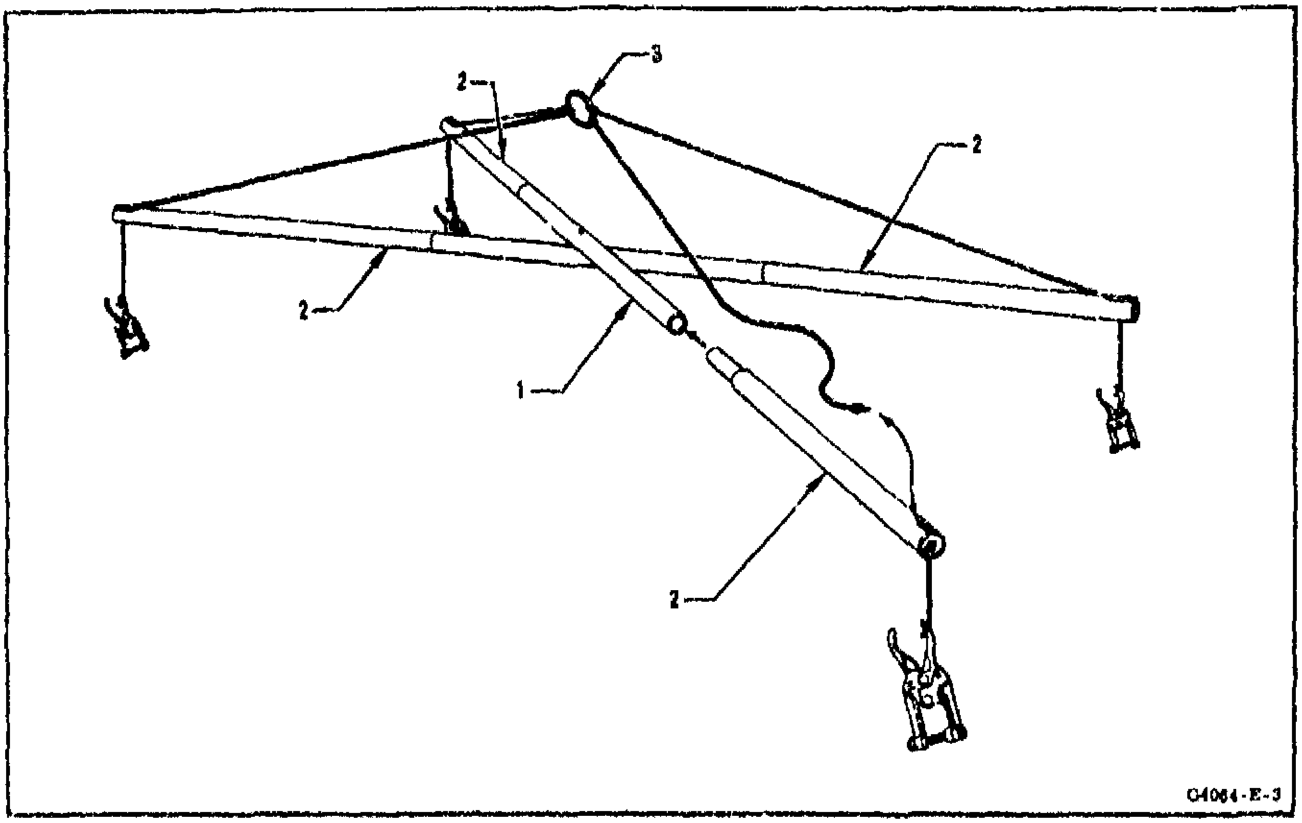
| | |
|---|---|
| Height | 70 inches |
| Width | 90 inches |
| Length | 148 inches |
| Weight | 3, 245 pounds |
| Tire Pressure | 75 ±5 psi |
| Towing Speed | 5 mph maximum |
| Turning Radius | 115 inches minimum |

Figure 22-2. Leading Particulars for Engine Handler

covered with reversible deck lids having elastic straps on one side to permit installation of desiccant bags. Removable guard rails are incorporated at the aft end of the handler to protect the engine thrust chamber. Tiedown points are located at the corners of the handler frame. Instruction plates are located on the frame and vertical struts for engine installation and handler transportation tiedown. A bead at the bottom of the engine cover is clamped with a formed steel retainer strip along the outer edge of the handler frame, to provide engine protection. Figure 22-2 lists leading particulars of the engine handler. Instructions for the use of the engine handler are in R-3825-3.

22-3. ENGINE HANDLER ACCESSORIES.

22-4. Engine handler accessories are used for special functions and are stored in the engine handler compartments when not in use. Figure 22-3 lists the accessories stored in the engine handler compartments.




| Index Number | Nomenclature |
|---|---|
| | Cover Assembly |
| | Security Cover |
| | Dust Cover |
| | Repair Kit |
| | Manual |
| | Dust Cover |
| | Pouch |
| 1 | Cross Frame (Cover Sling) |
| | Tube |
| 2 | Extension (Cover Sling) |
| | Clamp |
| | Tube |
| | Insert |
| 3 | Harness (Cover Sling) |

Figure 22-3. Engine Handler Accessories

22-5. CONFIGURATION CHANGES--MANUAL EFFECTIVITY.

22-6. The modifications incorporated changing configuration of the engine handler are listed in figure 22-4.

| Approved ECP No. | MD No. | Incorporated in Manual Dated |
|---|---|---|
| J2-182 | 1 | 30 July 1964 |
| J2-184 | 2 | 30 July 1964 |

Figure 22-4. Configuration Changes--Manual Effectivity

22-7. MAINTENANCE OF ENGINE HANDLER.

22-8. Maintenance tasks required on the engine handler are listed in figure 22-5. The information presented lists the tasks to be performed, when the tasks must be performed, and reference to data necessary to accomplish these tasks. Refer to R-5101, J-2 Rocket Engine Maintenance Plan, for ground support equipment repair schedule. Maintenance tasks include adjusting steering and brakes, painting, repairing, and preparation for storage.

22-9. ALINING ENGINE HANDLER STEERING. Alining steering assembly consists of adjusting the tie rods to aline the front casters parallel to each other and to the tongue.

a. Disconnect tie rods from caster steering arms.

b. Position front casters and tongue parallel to centerline of handler.

c. Adjust tie rod ends until boltholes aline within 1/2 turn of boltholes in caster steering arms. Aline boltholes; install bolts, washers, and nuts; and torque bolts. Refer to Torque Values for Threaded Fasteners in R-3825-5, Volume I.

22-10. ADJUSTING ENGINE HANDLER BRAKES. Adjusting caster brakes consists of positioning each brake to apply the required force to its caster wheel without overloading the brake lever.

a. With brake lever in fully up position and tire properly inflated, push brake shoe toward brake housing as far as possible.

b. Loosen bolts attaching brake to mounting bracket, and position brake to obtain a clearance of 7/16 (+0, -1/16 inch) between brake shoe and tire.

c. Secure brake to mounting bracket and torque nuts. Refer to Torque Values for Bolts, Nuts, and Screws in R-3825-5, Volume I.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect engine handler for: | | | | | |
| Completeness. | X | X | | X | Prior to shipment. See figures 22-1 and 22-3 |
| Shipping and handling damage. | X | | | | Repair engine handler. Refer to paragraph 22-12. Touch up paint. Refer to paragraph 22-11. |
| Legibility of identification plates. | | X | | | Replace damaged plates. Refer to paragraph 22-8. |
| Front caster alinement | | | | X | Whenever evidence of excessive tire wear, misalinement, or damage exists. Refer to paragraph 22-9. |
| Inspect GSE MAINTENANCE SERVICE plate for current service effectivity, applicable to the following: | X | | | X | Every 6 months. Subsequent to completion of service, install new GSE MAINTENANCE SERVICE plate with effective dates. Locate plate next to engine handler nameplate. |
| Lubricate engine handler. | | | | X | Every 6 months and whenever movement is restricted. Refer to paragraph 22-12B. |
| Adjust brakes. | | | | X | Every 6 months, whenever a tire is replaced, whenever brake shoe to tire clearance exceeds 7/16-inch, and whenever evidence of inoperative brakes exists. Refer to paragraph 22-10. |
| Inflate tires to 75 ±5 psig. | | | | X | Every 6 months. |
| Inspect steering and tow bar for: | | | | | |
| Restricted movement of tie rods, latch, and tow bar. | | X | | | Lubricate restricted part. Refer to paragraph 22-12B. If restriction is not eliminated, replace part. Refer to paragraph 22-8. |
| Exposed tie rod threads for corrosion. | | X | | | Remove corrosion with wire brush. Apply preservative WD-40 (Rocket Chemical Co), or equivalent. |

Figure 22-5. Maintenance Requirements for Engine Handler (Sheet 1 of 3)

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect yoke for: | | | | | |
| Restricted bearing movement. | | X | | | Lubricate yoke bearings. Refer to paragraph 22-12B. If restriction is not eliminated, replace part. Refer to paragraph 22-8. |
| Frayed or broken lockpin cables. | | X | | | Replace cable. Refer to paragraph 22-8. |
| Inspect retainer bolts for damaged threads. | | X | | | Replace damaged bolt. Refer to paragraph 22-8. |
| Inspect slide lock for restricted movement. | | X | | | Lubricate slide lock. Refer to paragraph 22-12B. |
| Inspect lockpins for restricted movement. | | X | | | Lubricate lockpins. Refer to R-3825-5, Volume I. |
| Inspect record container for: | | | | | |
| Damaged seal. | | X | | | Replace record container. Refer to paragraph 22-8. |
| Inoperative locks. | | X | | | Replace record container. Refer to paragraph 22-8. |
| Inspect engine covers for broken seams and torn or punctured surfaces. | | X | | | Repair covers. Refer to paragraph 22-11A. |
| Clean exterior and interior surfaces. | | X | | | Refer to R-3825-5, Volume I. |
| Clean engine cover and engine dust cover. | | X | | | Clean covers thoroughly with a solution of 4-6 ounces of mild alkaline cleaner RB0210-002 or RB0210-005 (Rocketdyne), or equivalent, for each gallon of water heated to 140° to 160° F. Rinse with clear water. Wipe with clean cheesecloth and allow to dry thoroughly. Inspect cover for cleanness using visual inspection method. (Refer to Inspecting for Cleanness in R-3825-5, Volume I.) |

Figure 22-5. Maintenance Requirements for Engine Handler (Sheet 2 of 3)

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
| --- | --- | --- | --- | --- | --- |
| Fold and store engine cover and engine dust cover. | | | | X | Subsequent to use. Refer to paragraph 22-13. |
| Clean, fold, and store handler dust cover. | | | | X | Whenever handler is in use. Store in handler storage compartment. Clean cover thoroughly with a solution of 4-6 ounces of mild alkaline cleaner RB0210-002 or RB0210-005 (Rocketdyne), or equivalent, for each gallon of water heated to 140° to 160° F. Rinse with clear water. Wipe with clean, lint-free cloth and allow to dry thoroughly. Inspect cover for cleanness using visual inspection method. (Refer to Inspecting for Cleanness in R-3825-5, Volume I.) |
| Install handler dust cover. | | | | X | Whenever handler is not in use. |
| Prepare handler for shipping. | | | | X | Prior to shipping. Refer to paragraph 22-13. |
| Prepare handler for storage. | | | | X | Whenever handler is not in use. Refer to paragraph 22-13. |

Figure 22-5. Maintenance Requirements for Engine Handler (Sheet 3 of 3)

22-11. PAINTING ENGINE HANDLER. Painting the engine handler consists of touching up exposed or scratched surfaces and stenciling obliterated markings. Paint requirements are as follows:

WARNING

The following specifies primer (MIL-P-8585), which is flammable and must not be used near heat, sparks, or open flame. It is toxic. Inhalation of its vapors or prolonged contact with the primer can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

a. Base coat: zinc chromate primer (MIL-P-8585).

b. Finish coat: orange-yellow enamel (MIL-E-7729, Type I), color 13538 (Federal Standard 595). Omit paint on fastener 9018230 shank and concave area.

c. Nonskid surface of deck lid: nonskid paint FERROX No. C-507WZ791115 (American Abrasive Metals Co), or equivalent.

d. Stripes on gates: black enamel (MIL-E-7729, Type I), color 17038 (Federal Standard 595).

e. Handle 9020255: red enamel (MIL-E-7729, Type I), color 11136 (Federal Standard 595).

f. Markings on engine handler surfaces: black lacquer (MIL-L-19538), color 37038 (Federal Standard 595).

g. Markings on deck lids nonskid surface: white lacquer (MIL-L-19538), color 37875 (Federal Standard 595).

h. Markings on engine handler dust cover: black stencil ink N-1 (Marsh Stencil Machine Co), or equivalent.

22-11A. REPAIRING ENGINE HANDLER COVERS. Repair engine handler cover, using repair kit provided with cover, as follows:

a. Repair all holes (larger than 1/16-inch in diameter), punctures, or tears, with a patch cut from material supplied in repair kit. Cut patch to extend 3/8 inch beyond periphery of damaged area. Cement patch in place with Testors vinyl cement (The Testors Corp) or adhesive VK-193-0030 (Navan Products). Large damaged areas may be reinforced by applying a patch to both sides of cover material.

b. Repair all holes 1/16 inch in diameter or less (but larger than 1/32 inch in diameter) with a drop of Testors vinyl cement (The Testors Corp) or adhesive VK-193-0030 (Navan Products).

c. Repair holes 1/32 inch in diameter or smaller, yet visible to the unaided eye, as in step b.

## 22-12. REPAIRING ENGINE HANDLER.

WARNING

> The following specifies adhesive EC1300L, which is flammable and must not be used near heat, sparks, or open flame. It is toxic. Inhalation of its vapors or prolonged contact with the adhesive can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

Repairing the engine handler consists of replacing defective parts. When replacing tow bar storage hanger protective rubber cushion (AMS 3208), cement with adhesive EC1300L (Minnesota Mining and Mfg), or equivalent.

a. Torque steering and two bar pivot bolt to 20-40 in-lb.

b. Torque caster attach nuts to 250-300 in-lb. (Install bolts head down.)

c. On bolt attaching yoke to frame, torque nut to 20-40 inch-pounds.

d. On bolt attaching clevis to yoke, torque nut to 275-325 inch-pounds.

e. On yoke, torque slide into ball until a 6-10 pound force, applied to the slide perpendicular to slide-ball centerline, will move slide-ball assembly.

22-12A. FOLDING ENGINE HANDLER ENGINE COVER. Before each folding sequence, wrinkles must be smoothed out and trapped air forced out.

a. Lay engine cover on a clean, flat surface. Make sure cover is clean. See figure 22-5 for cleaning procedures.

b. Protect cover by wrapping buckles with general purpose tape.

c. Position cover with NASA marking up and centered with FWD and AFT marking at 2 corners.

d. Fold AFT and FWD ends towards center so that each end touches respective cover straps. Cover forms rectangle.

e. Fold FWD end toward center, alining edge with center of NASA marking, then fold AFT end to opposite edge, forming a rectangle approximately 4 by 9 feet.

f. Fold cover in half, forming a rectangle approximately 2 by 9 feet, then fold into thirds across width of cover, forming a rectangle approximately 2 by 3 feet.

g. Place folded engine cover in cover pouch.

22-12B. LUBRICATING ENGINE HANDLER. The permanently lubricated caster axle and swivel bearings require no lubrication. Subsequent to lubricating engine handler, make sure excessive lubricant is removed.

a. Lubricate yoke bearings as follows:

(1) If an engine is not installed on handler, lubricate bearings with Molykote Z powder (Dow Corning Corp), or equivalent. Rotate bearings in retainer to make sure lubricant is applied uniformly to all bearing surfaces.

(2) If an engine is installed on handler, lubricate accessible surfaces of bearing and installed bolt with preservative WD 40 (Rocket Chemical Co), or equivalent.

b. Remove tow bar, steering assembly at tie rod ends, and tongue pivot bolt. Apply light film of grease (MIL-G-23827) to mating surface of tongue mounting bracket and pivot bolt bearing surface. Rotate tie rod end bearings in retainer to make sure lubricant is applied uniformly to bearing surface. Apply preservative WD-40 (Rocket Chemical Co), or equivalent, to threads and exposed surfaces of bearings and tie rod ends.

c. Assemble steering assembly. Torque pivot bolt to 20-40 inch-pounds.

d. Apply light film of grease (MIL-G-23827) to tow bar and tongue mating surface and bearing surface of attach pin. Install tongue.

e. Lubricate slide lock surfaces as follows:

(1) If an engine is not installed on handler, apply a light film of gear grease (MIL-G-23827) to slide lock while operating slide lock handle to make sure lubricant is applied on all sliding surfaces.

(2) If an engine is installed on handler, lubricate accessible sliding surfaces with preservative WD-40 (Rocket Chemical Co), or equivalent, while operating slide lock handle.

f. Lubricate rear caster lock pins, brake lever actuators, and tow bar latch with lubricating oil (Federal Specification VV-L-800) or equivalent.

22-13. PREPARING ENGINE HANDLER FOR STORAGE OR SHIPMENT.

22-14. To prevent undue deterioration of handler dust cover, it is recommended that handler be stored in a sheltered area. Prepare handler for storage or shipment as follows:

a. Remove accessories from engine handler storage compartments.

b. Clean compartments. Refer to Cleaning in R-3825-5, Volume I.

c. Place engine cover 19-9025138-11 or 19-9020629-11 and engine dust cover 19-9025138-41 or 19-9020629-21 in cover pouch 9022820. Refer to paragraph 22-12A to fold covers.

d. Remove plugs from drain holes in storage compartments. Store plugs in same compartments.

NOTE

Removal of plugs from drain holes is not necessary when storing engine handler in a sheltered area.

e. Place all accessories in storage compartments except dust cover (figure 22-3). Make sure accessories are positioned to allow adequate drainage.

eA. Position retainers in place and secure with captive bolts. Tighten bolts handtight.

f. Install handler dust cover. Make sure dust cover is not damaged.

g. Secure dust cover to handler when shipping or when storing in an unsheltered area, without restricting air circulation beneath cover.

h. Inflate handler tires to 75 ±5 psig.

i. Detach and store tow bar on handler storage rack.

# SECTION XXIII

# ENGINE VERTICAL INSTALLER G4035

WARNING

ENGINE VERTICAL INSTALLER G4035 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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Underlined titles denote primary paragraphs.

## 23-1. DESCRIPTION AND LEADING PARTICULARS OF ENGINE VERTICAL INSTALLER.

23-2. Engine Vertical Installer G4035 (figure 23-1) is a mobile rotating stand used for installation and removal of the J-2 Rocket Engine in a test facility or the vehicle stage. The vertical installer consists of a rectangular base mounted on free-swiveling casters, which incorporate dual wheels, parking brakes, and position locks. A support ring is bearing-mounted on three-point suspension and can be manually rotated 360 degrees. A hand brake attached to the base is used to hold the support ring in position. The support ring may be placed in a normal position or a lowered position, 17-1/2 inches from the normal, by substituting long hangers stored on the support ring for the short hangers. Lowering the support ring allows an overhead gimbal clearance of 160 inches to facilitate installation of the engine in the SIVB stage. Two motor-drive hoists, attached to the sides of the base, are used with overhead pulleys to raise or lower the engine onto the installer. Attaching brackets for the tow bar are welded to all four sides, permitting towing of the vertical installer in any direction. Storage compartments are built into both ends of the base for storage of the hoist remote-control station equipment and accessory equipment (paragraph 23-3). The tow bar is stored externally in the folded position on the vertical

installer. As an integrated safety feature, an alarm connected to the hoist electrical system is sounded whenever the installer frame exceeds a 3-degree tilt during installation. An explosion-proof controller box, housing all the electrical relays, terminal blocks, and alarm system switches, is at one end of the vertical installer. The remote-control station containing hoist operating switches is mounted on a 75-foot electrical cable enabling the operator to control engine installation or removal from any position. The installer hoist cables are routed to overhead pulleys, which are mounted on engine test stand or vehicle stage, then to the engine. As the hoists are operated, the engine is lowered or raised as desired. The hoists are operated individually or simultaneously, at either slow or fast speed. With the engine on the installer, either winch cable may be attached to an anchorage and the installer self-winched to a desired locati[illegible] A caster wrench is used to guide the installer. The installer may also be towed from any of the four sides. On installers incorporating MD2 change, the cable termination housing was reworked to provide clearance. Installers incorporating MD4 change have been modified by the customer to add three screw jacks, which provide an alternate method of raising the engine for installation. Leading particulars for the installer are listed in figure 23-2. Instructions for the use of the engine vertical installer are in R-3825-3.

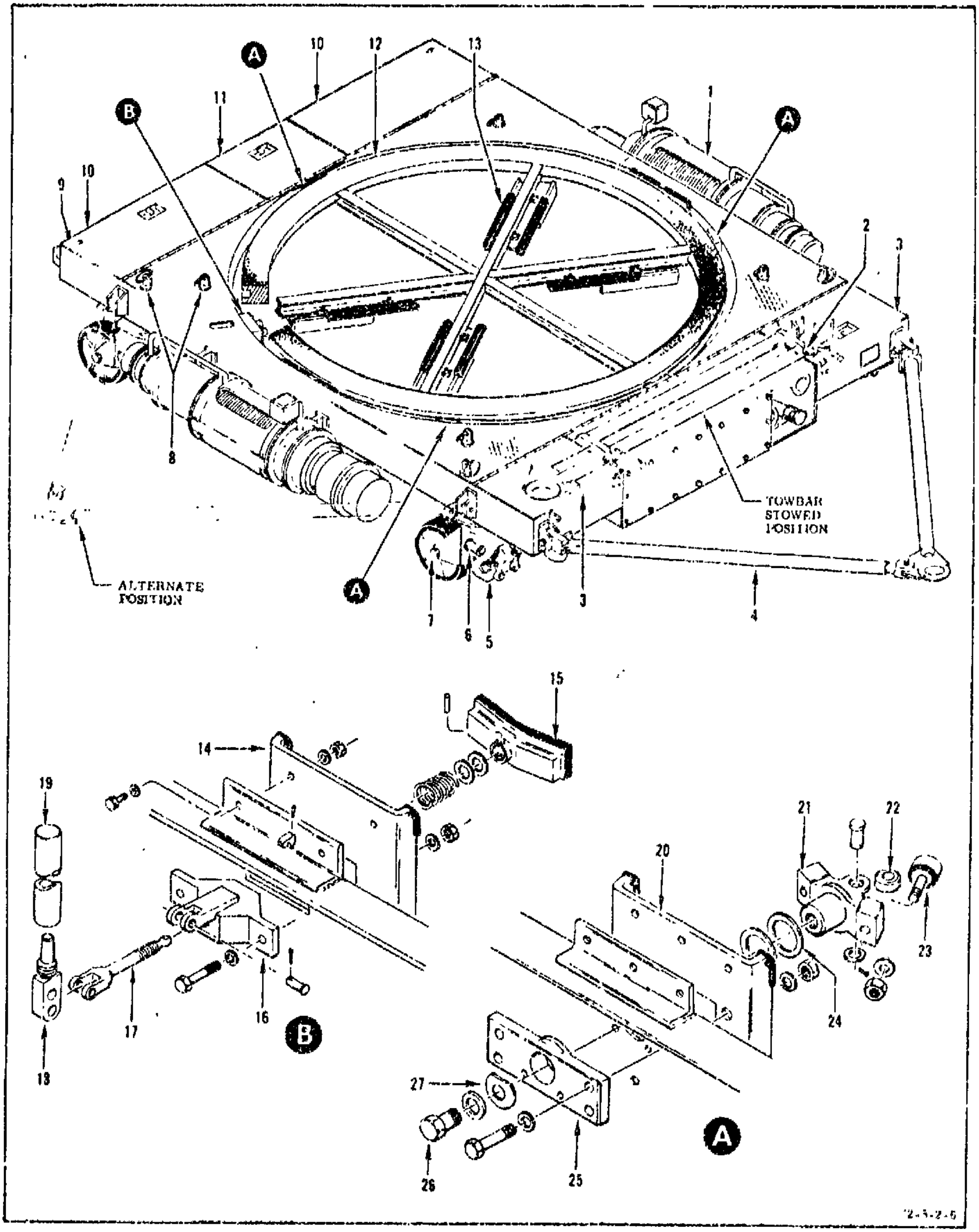



Figure 23-1. Engine Vertical Installer (Sheet 1 of 3)

| Index No. | Part No. | Nomenclature |
|---|---|---|
| | G4035 | Engine Vertical Installer |
| 1 | 2X3W15-5 | Hoist system |
| | AN14-22A | Bolt |
| | LD153-0010-0025 | Washer |
| | MS20500-1414 | Nut |
| | AN12-20A | Bolt |
| | MS20500-1216 | Nut |
| | LD153-0010-0023 | Washer |
| | NAS1099-12 | Washer |
| | MS21919WH12 | Clamp |
| | AN520C10-16 | Screw |
| | NAS679C3 | Nut |
| | LD153-0010-0007 | Washer |
| | MS21919WH15 | Clamp |
| | AN520C10-8 | Screw |
| | AN520C10-12 | Screw |
| 2 | 3100204C026-010 | Strap |
| | LD153-0010-0009 | Washer |
| | MS20500-428 | Nut |
| | NAS1099-4 | Washer |
| | NAS1211C101 | Fitting |
| | NAS679C4W | Nut |
| 3 | 9021037-11 | Access lid |
| | 24-10-302-10 | Fastener |
| | MS20426AD4 | Rivet |
| | MS20253-512 | Hinge pin |
| | AN3-6A | Bolt |
| | LD153-0010-0007 | Washer |
| | NAS679A3W | Nut |
| 4 | 9021027 | Drawbar |
| | 9021028 | Bar |
| | 9021030 | Latch |
| | MS171655 | Spring pin |
| | 9021029 | Bar |
| | MS20392-10C83 | Pin |
| | MS9245-66 | Cotter pin |
| | RD191-2001-2210 | Cable |
| | SLS-12R31 | Pin |
| | 28-2-G | Sleeve |
| 5 | 51478 | Bracket |
| | AS65-46 | Screw |
| | MS35334-19 | Lockwasher |
| | 51665-R | Brake |
| | 51665-L | Brake |
| 5 (cont) | AS60-6-16 | Screw |
| | AS364-624 | Nut |
| | AN960-616 | Washer |
| 6 | 51487MA | Socket |
| | A[illegible]509-516R19 | Screw |
| | AN960-516 | Washer |
| | AS365-524 | Nut |
| | 5419MA | Swivel |
| | AN10-20A | Bolt |
| | AN10-22A | Bolt |
| | LD153-0010-0021 | Washer |
| | MS20500-1018 | Nut |
| 7 | 12766-4 | Caster |
| 8 | 5015 | Ring |
| 9 | RD171-1032-0001 | Proof-load identification plate |
| 10 | 9021037 | Outboard lid |
| | 24-10-302-10 | Fastener |
| | MS20426AD4 | Rivet |
| | MS20253-512 | Hinge pin |
| | AN3-6A | Bolt |
| | LD153-0010-0007 | Washer |
| | NAS679A3W | Nut |
| 11 | 9021039 | Center lid |
| | AN3-6A | Bolt |
| | LD153-0010-0007 | Washer |
| | NAS679A3W | Nut |
| 12 | 9021052 | Support ring |
| | 9021052-9 | Pad |
| | AN526-1032R12 | Screw |
| | AN4-14A[a] | Bolt |
| | LD153-0010-0010[a] | Washer |
| | NAS679C4W[a] | Washer |
| | NAS1099-6[a] | Washer |
| | 950-4[a] | Washer |
| | 955-4[a] | Washer |
| 13 | 9021055[b] | Long hanger |
| | 9021056[b] | Long brake hanger |

(a) Used to stow hangers on support ring.
(b) Stowed on support ring.

Figure 23-1. Engine Vertical Installer (Sheet 2 of 3)

| Index No. | Part No. | Nomenclature |
|---|---|---|
| 14 | 9021057 | Brake hanger |
| | AN7-12A | Bolt |
| | LD153-0010-0016 | Washer |
| | MS20500-720 | Nut |
| | 9022163 | Brake |
| | AN8-16A | Bolt |
| | LD153-0010-0018 | Washer (8 supplied; use as required) |
| | MS20500-820 | Nut |
| 15 | 9021023 | Shoe |
| | MS171596 | Pin |
| 16 | 9022162 | Plate |
| 17 | 9022161 | Plunger |
| | D79 | Spring |
| | LD153-0010-0022 | Washer |
| | MS20364-1018 | Nut |
| 18 | 9021043 | Actuator |
| | MS171715 | Pin |
| 19 | 9021044(c) | Handle |
| 20 | 9021054 | Short hanger |
| | AN7-12A | Bolt |
| | LD153-0010-0015 | Washer |
| | MS20500-720 | Nut |
| 20 (cont) | 9021020 | Holder |
| | AN6-17A | Bolt |
| | AN7-36A | Bolt |
| | AN8-20A | Bolt |
| | LD153-0010-0013 | Washer |
| | LD153-0010-0015 | Washer |
| | LD153-0010-0017 | Washer |
| | MS20500-624 | Nut |
| | MS20500-720 | Nut |
| | MS20500-820 | Nut |
| 21 | 9021019 | Housing |
| 22 | HASB-8 | Bearing |
| | LD153-0010-0018 | Washer |
| | MS20392-7643 | Pin |
| | MS24665-283 | Cotter pin |
| 23 | CR-28 | Cam follower |
| | MS20364 | Nut |
| | LD153-0010-0023 | Washer |
| 24 | LD153-0010-0032 | Washer |
| 25 | 9021018 | Plate |
| 26 | NAS1228C5L | Bolt |
| | LD153-0010-0017 | Washer |
| 27 | 9021019 | Washer |

(c) Stowed in compartment.

Figure 23-1. Engine Vertical Installer (Sheet 3 of 3)

| | |
|---|---|
| Height | 26 inches |
| Width | 122.50 inches |
| Length | 124 inches |
| Weight | 4,700 pounds |
| Towing speed | 2-1/2 mph maximum |
| Power requirements | 440 vac, 3-phase, 60 cps |
| Power cable length | 75 feet |
| Hoist motor capacities | 1.5 and 0.5 horsepower |
| Hoist lifting capacity | 3,000 pounds per hoist |
| Hoist cable length | 79 feet |
| Hoist speed, slow | 2.5 to 6.5 ft/min |
| Hoist speed, fast | 8.5 to 18.5 ft/min |
| Remote-station operating power | 115 vac, single phase, 60 cps |
| Ground clearance | 7 inches (support ring in normal position)<br>2 inches (support ring in lowered position) |

Figure 23-2. Leading Particulars for Engine Vertical Installer

## 23-3. ENGINE VERTICAL INSTALLER ACCESSORIES.

23-4. Engine vertical installer accessories (figure 23-3) are used for special functions and stored in installer compartments when not in use.

| Part No. | Nomenclature |
|---|---|
| 9021698 | Cable termination assembly |
| 9021698-11[a] | Cable termination assembly |
| 9020648 | Housing |
| 9020648-3[a] | Housing |
| 9020649 | Wedge |
| 9020946 | Ramp |
| 9020986 | Retainer |
| 9020996 | Bolt |
| 9020997 | Bolt |
| 9020998 | Block |
| 9025128 | Collar |
| AN10-11 | Bolt |
| BLC3C108 | Ball-lock pin |
| NAS1100-5-10 | Screw |
| NAS568-43 | Bolt |
| MS20002-C10 | Washer |
| MS20010-10 | Bolt |
| RD191-2002-1212 | Cable |
| 28-1-C | Sleeve |
| 9021000-11 | Fuel-side center and outboard engine bracket |
| 334-7-7 | Bolt |
| LD153-0011-0019 | Washer |
| 9022273 | Oxidizer-side center engine bracket |
| 9021001 | Oxidizer-side center engine bracket |
| 334-8-16 | Bolt |
| 9021002 | Oxidizer-side outboard engine bracket |
| 334-614 | Bolt |
| 334-8-15 | Bolt |
| LD153-0010-0013 | Washer |
| LD153-0010-0017 | Washer |
| 9021003 | Outboard engine pier |
| 9021031 | Spanner wrench |
| 9021032 | Arm |
| 9021033 | Handle |
| 9021034 | Knob |
| BLDS-6-13 | Pin |
| LD153-0011-0022 | Washer |
| MS9245-66 | Pin |
| MS20364-820C | Nut |
| MS20392-9C43 | Pin |
| RD191-2001-2210 | Cable |
| 28-2-G | Sleeve |
| 9021044 | Support ring brake handle |
| 9022099 | Engine tiedown harness |
| 9021047 | Tiedown strap |
| 9021048 | Tiedown strap |
| 9022097 | Girth strap |
| 9021051 | Long tie rod |
| 9021050 | Tie rod |
| HRY-10AFN | Rod end |
| HRYL-10AFN | Rod end |
| AN316-12V | Nut |
| AN316-12R | Nut |
| RD191-2002-1112 | Cable |
| RD191-4001-0008 | Lug |
| NAS1340A5C19D | Pin |
| 28-1C | Sleeve |
| 9021053 | Short tie rod |
| 9021049 | Tie rod |
| HRY-10AFN | Rod end |
| HRYL-10AFN | Rod end |
| AN316-12V | Nut |
| AN316-12R | Nut |
| RD191-2002-1112 | Cable |
| RD191-4001-0008 | Lug |
| NAS1340A5C19D | Pin |
| 28-1-C | Sleeve |
| 9022158 | Oxidizer-side pin |
| 9022159 | Fuel-side bracket |
| BLV-8-CL-16 | Pin |
| RD191-2001-2210 | Cable |
| 28-2-G | Sleeve |
| 9022160 | Fuel-side keeper |
| 19-9021036-3 | Protective cover |
| 19-9021036-5 | Pouch |
| 19-9021036-7 | Cover repair kit |
| 19-9021036-9 | Instruction manual |
| 19-9021036-11 | Strap |
| MS20392-9C63 | Pin |
| MS24665-353 | Pin |
| LD153-0010-0021 | Washer |
| 9025858 | Support |

(a) On installers incorporating MD2 change

Figure 23-3. Engine Vertical Installer Accessories

23-5. CONFIGURATION CHANGES--MANUAL EFFECTIVITY.

23-6. Modifications incorporated in this section that change the configuration of the engine vertical installer are listed in figure 23-4.

| Approved ECP No. | MD No. | Incorporated in Manual Dated |
|---|---|---|
| J2-209 | 1 | 21 May 1965 |
| J2-454 | 2 | 19 October 1965 |
| J2-464 | 3 | 3 May 1966 |
| J2-487 | 4 | 3 May 1966 |
| J2-673 | 5 | 17 November 1969 |

Figure 23-4. Configuration Changes--Manual Effectivity

23-7. HANDLING ENGINE VERTICAL INSTALLER.

23-8. The engine vertical installer can be towed from any of the four sides by attaching the tow bar, swiveling the four casters into a trail position, and locking the two rear casters (opposite side on which the tow bar is attached) using swivel locks. Casters adjacent to the tow bar must be free-swiveling. When locking or unlocking caster swivel locks, use caster spanner wrench to relieve locking mechanism side loads. Maximum towing speed is 3-1/2 mph. Extreme care must be used when the installer is moved with the ring in the lowered position. A safety chain must be used between installer and towing vehicle. The installer can be lifted by attaching a sling (5,000-pound minimum capacity) to lifting rings provided on each corner of the installer. There are no provisions for using a forklift to handle the installer. The remote-control station cable forms a loop as it enters the station end fitting. This loop must not be used as a handle.

CAUTION

Handling the installer with a forklift can damage the installer electrical system.

- Handling the remote-control station by holding the cable loop can cause wire breakage within the station end fitting.

23-9. MAINTENANCE OF ENGINE VERTICAL INSTALLER.

23-10. Maintenance tasks required on the engine vertical installer are listed in figure 23-5, which also indicates when the tasks must be performed and where data support for the tasks can be found. See figures 23-1 and 23-3 for parts replacement identification. Maintenance tasks include function testing; proof testing; adjusting hoist, brakes, caster brakes, and tilt alarm system; lubricating; painting; and preparation for storage.

23-11. FABRICATING GROUND CABLE.

23-12. Fabricate a ground cable before initial use: store in installer for future use.

a. Use Super-Service welding cable No. 4 AWG (General Cable Corp), or equivalent. If installer is to be self-winched, ground cable must be of sufficient length (approximately 79 feet).

b. Attach clamp 31224 (Thomas and Betts Co), or equivalent, at each end of ground cable.

c. Make sure resistance of ground cable is less than one ohm.

d. Identify as engine vertical installer ground cable, and store in installer storage compartment.

23-13. FUNCTION-TESTING ENGINE VERTICAL INSTALLER.

CAUTION

Care must be used when removing the remote-control station and cable from the compartment, to prevent placing a strain on the cable where it enters the remote-control station. Excessive strain can cause damage to electrical wires at the entry point.

a. Carefully remove remote-control station from installer storage compartment, and remove any kinks that occur. Do not pull cable from storage compartment by pulling on remote-control station, and do not use cable loop at remote-control station as a handle. Place remote-control station at a safe working distance from installer.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect installer for completeness. | X | X | | | See figures 23-1 and 23-3. |
| Inspect caster brakes for positive locking action. | X | X | | | Adjust brakes. Refer to paragraph 23-19. |
| Inspect protective cover for missing or damaged grommets and torn surfaces. | X | X | | | Repair covers. Refer to paragraph 23-36. |
| Inspect draw bar and accessory equipment lockpins for restricted movement. | X | X | | | Lubricate lockpins. Refer to R-3825-5, Volume I. |
| Inspect painted surfaces for nicks, scratches, and exposed surfaces. | X | | | | Paint exposed surfaces. Refer to paragraph 23-22. |
| Inspect hoist cables for frayed or broken strands. | X | X | | | Replace hoist cables. Refer to paragraph 23-35. |
| Inspect caster wheels for flat spots and nicks. | X | X | | | Replace damaged caster. See figure 23-1. |
| Inspect caster swivel lock for: | | | | | |
| Locking action | X | X | | | Replace swivel lock. |
| Restricted movement | X | X | | | Lubricate swivel locks with lubricating oil (Federal Specification VV-L-800), or equivalent. |
| Inspect caster for damaged steering sockets. | X | X | | | Replace steering socket. See figure 23-1. |
| Inspect support ring groove and cam followers for dirt and foreign matter. | | X | | | Clean support ring. Refer to Cleaning in R-3825-5, Volume I. |
| Inspect support ring hangers for damaged or missing protective pads. | X | X | | | Replace damaged or missing protective pads. Refer to paragraph 23-32. |
| Inspect controller box for corrosion. | | | | X | Every 120 days. Refer to paragraph 23-41. |
| Lubricate hoist cables. | | | | X | Every 30 days. Refer to paragraph 23-21. |

Figure 23-5. Maintenance Requirements for Engine Vertical Installer (Sheet 1 of 2)

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect gear end and motor end cavities of hoists for proper oil level. | | | | X | Every 30 days. Fill to proper level. Refer to paragraph 23-21. |
| Change oil in gear end and motor end cavities of hoists. | | | | X | Every 6 months. Refer to paragraph 23-21. |
| Grease hoist bearings. | | | | X | Every 30 days. Refer to paragraph 23-21. |
| Clean installer. | | X | X | | Handwipe surfaces. Refer to Cleaning in R-3825-5, Volume I. |
| Function-test installer. | | X | | | Refer to paragraph 23-13. |
| Proof-test installer. | | | | X | Every 6 months and whenever hoist or cables are replaced. Refer to paragraph 23-14. |
| Prepare installer for storage. | | | X | | Refer to paragraph 23-24. |

Figure 23-5. Maintenance Requirements for Engine Vertical Installer (Sheet 2 of 2)

b. Make sure switches on remote-control station and facility electrical supply source are in off position.

c. Connect vertical installer ground cable (paragraph 23-11) between installer frame and facility ground. Make sure paint does not insulate connections.

WARNING

An improperly wired power cable can cause an electrical potential between the vertical installer frame and ground, resulting in death to personnel if contact is made between the vertical installer and ground when the ground cable is not connected.

d. Make sure electrical power cable is wired so that engine vertical installer frame has same ground potential as facility (figure 23-6).

e. Install electrical plug into installer receptacle QEH42634S22 (Crouse-Hinds) and twist receptacle clockwise; push plug in, to complete electrical connection. Connect installer to a facility electrical power source capable of supplying 440 vac and protected to 35 amps.

f. Turn facility electrical power on. MAIN POWER ON light on remote-control station comes on.

g. Move remote-control HOIST selector switch to DUAL.

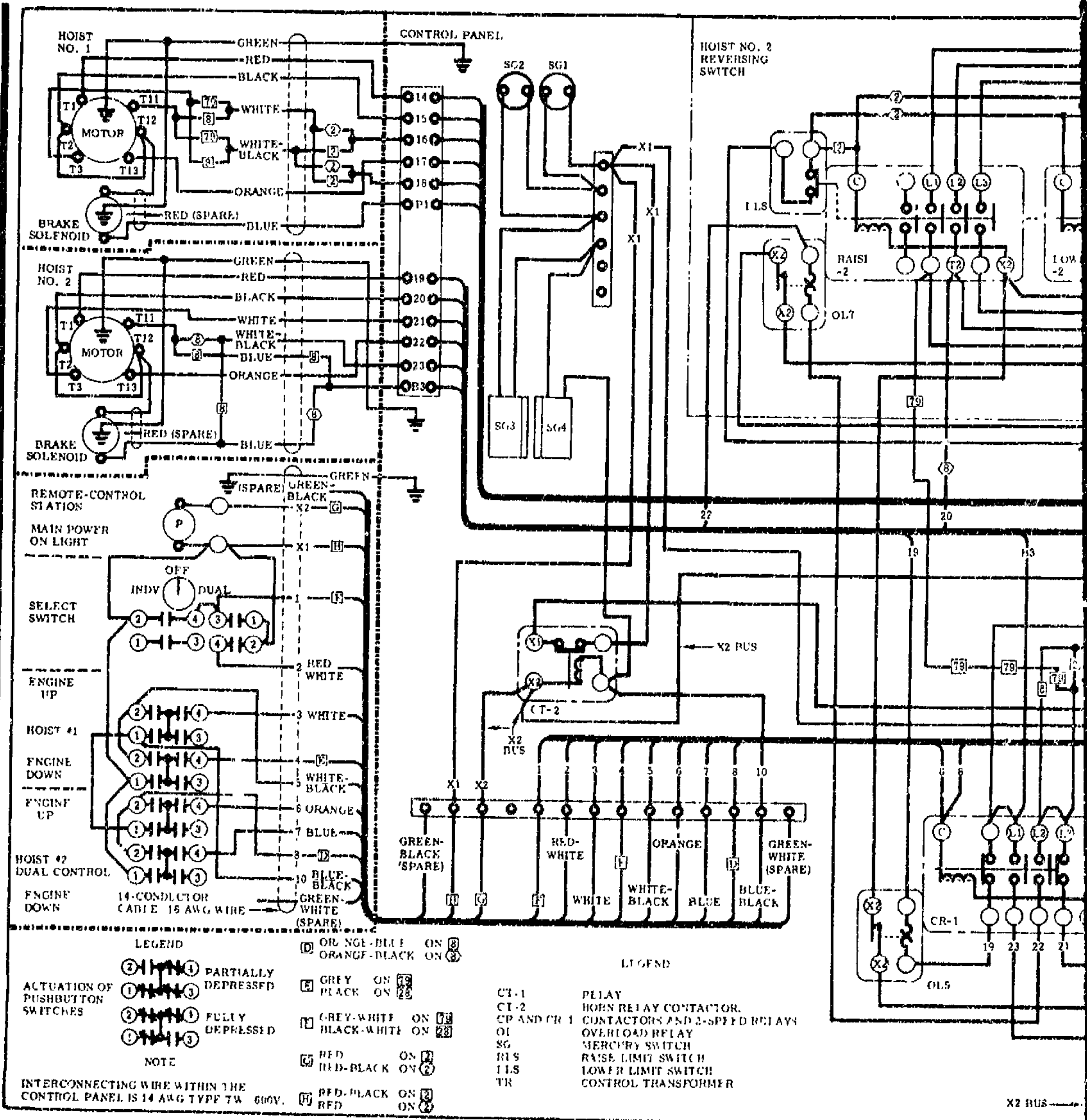
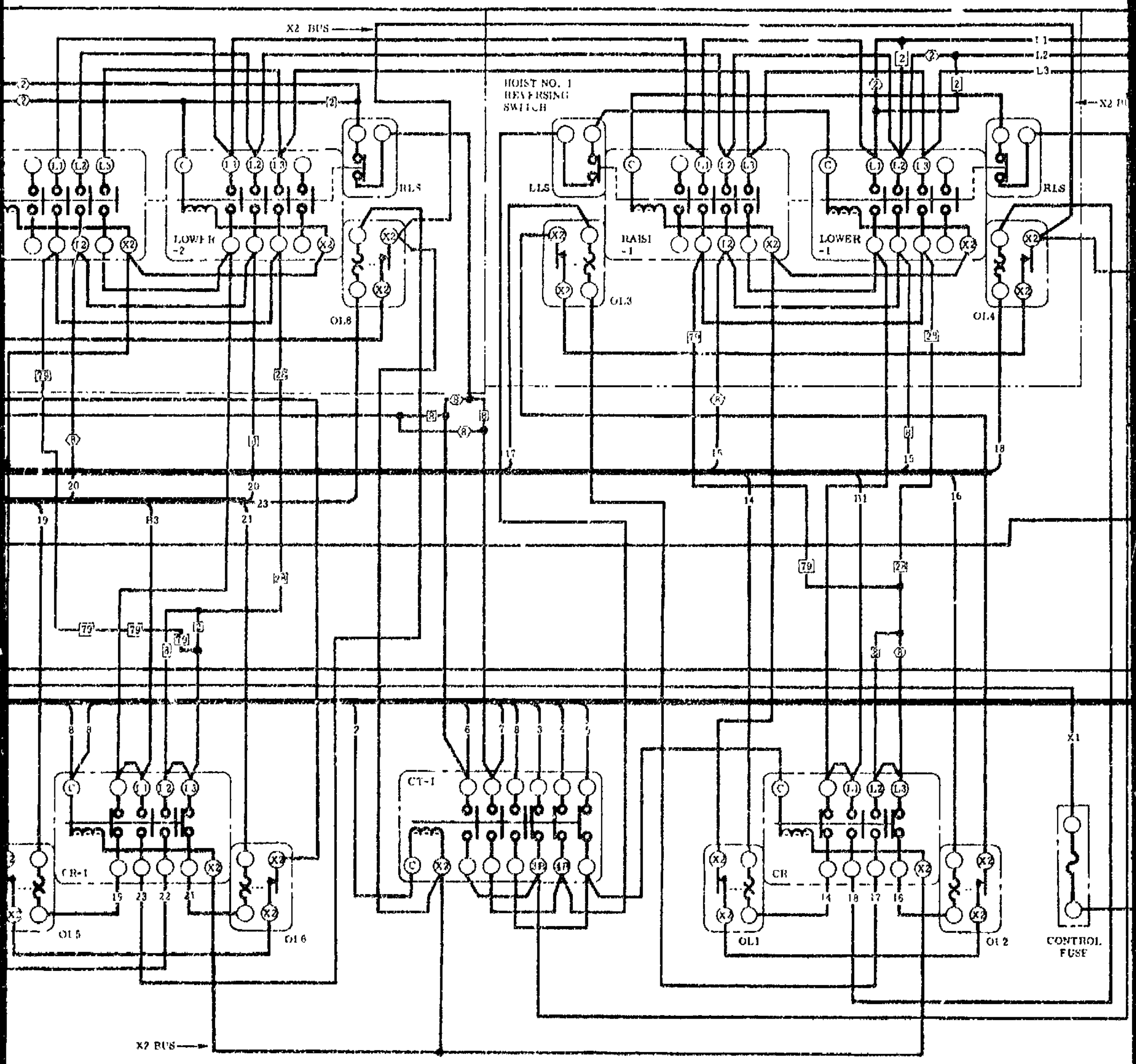
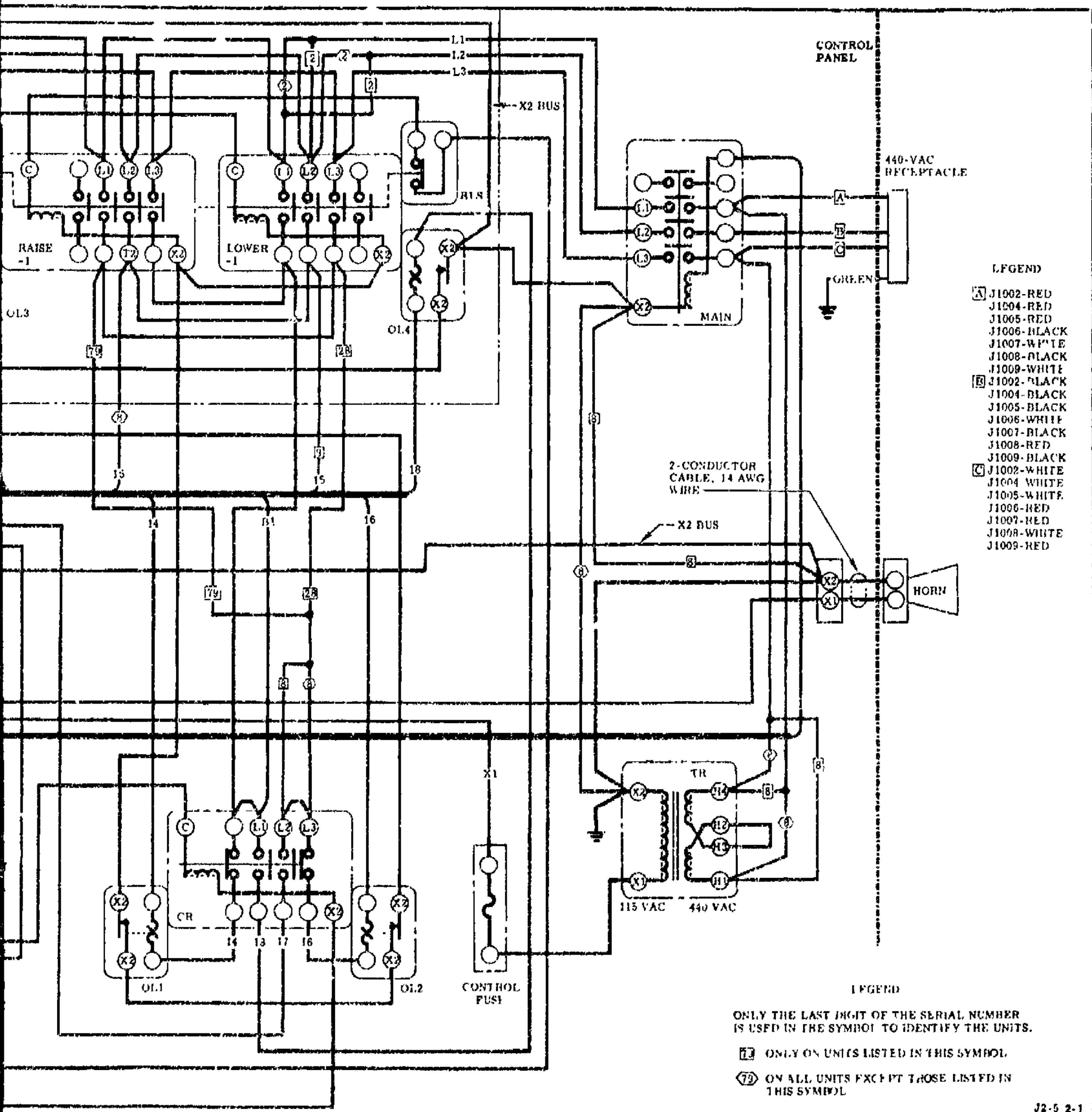



Figure 23-6. Engine Vertical Installer Electrical Shematic


X2 BUS
HOIST NO. 1
REVERSING
SWITCH
L1
L2
L3
X2 BUS
RLS
LLS
RLS
LOWER
-2
RAISE
-1
LOWER
-1
OL6
OL3
OL4
CR-1
OL5
OL6
CT-1
CR
OL1
OL2
CONTROL
FUSE
X1
X2 BUS



CONTROL PANEL
440-VAC RECEPTACLE
L1
L2
L3
X2 BUS
RAISE -1
LOWER -1
BLS
OL3
OL4
MAIN
GREEN
HORN
2-CONDUCTOR CABLE, 14 AWG WIRE
TR
115 VAC
440 VAC
CR
OL1
OL2
X1
CONTROL FUSE
LEGEND
A J1002-RED
J1004-RED
J1005-RED
J1006-BLACK
J1007-WHITE
J1008-BLACK
J1009-WHITE
B J1002-BLACK
J1004-BLACK
J1005-BLACK
J1006-WHITE
J1007-BLACK
J1008-RED
J1009-BLACK
C J1002-WHITE
J1004 WHITE
J1005-WHITE
J1006-RED
J1007-RED
J1008-WHITE
J1009-RED
LEGEND
ONLY THE LAST DIGIT OF THE SERIAL NUMBER IS USED IN THE SYMBOL TO IDENTIFY THE UNITS.
13 ONLY ON UNITS LISTED IN THIS SYMBOL
79 ON ALL UNITS EXCEPT THOSE LISTED IN THIS SYMBOL
J2-5 2-1

WARNING

Protective gloves must be worn when handling the cable to prevent injury to hands.

CAUTION

Make sure that the cables are reeling out; if not, hoist rotation may be reversed.

NOTE

The hoist will operate at slow speed when the remote-control station buttons are partially depressed and at fast speed when fully depressed.

h. Partially depress HOIST #2 ENGINE DOWN button. Both hoists must reel out cable.

NOTE

Cables must lie smoothly in the grooves of the hoisting drum and must not be dragged along the surfaces of the working area during winching operations.

i. Perform steps j through m if hoists do not reel out cable. Proceed to step n if hoist operation is satisfactory.

j. Turn facility electrical power off. MAIN POWER ON light on remote-control station must go off.

k. Remove cover from installer controller box.

NOTE

Two extreme upper boltholes of the controller box cover are threaded, enabling the lifting eyes to be installed.

l. Reverse any 2 of the 3 main power leads L1, L2, and L3 on terminal strip. (See electrical schematic, figure 23-6.)

m. Turn facility electrical power on. MAIN POWER ON light on remote-control station must come on. Repeat step h.

n. Depress HOIST #2 ENGINE UP button. Both hoists must reel in cables.

o. Move HOIST selector switch to INDV.

p. Depress HOIST #1 ENGINE DOWN button. HOIST NO. 1 must reel out cable.

q. Depress HOIST #1 ENGINE UP button. HOIST NO. 1 must reel in cable.

r. Repeat steps p and q for HOIST NO. 2, using applicable HOIST #2 buttons.

s. Connect 2 lifting slings (3,000-pound capacity each) between 2 tiedown rings on installer HOIST NO. 1 side and an overhead hoist.

t. Slowly raise side of installer. Alarm must sound when installer is raised 6 ±1 inches.

u. Repeat steps s and t on each side of installer until all 4 sides have been tested. Refer to paragraph 23-20 to adjust alarm.

v. Remove test equipment and secure installer.

## 23-14. PROOF-TESTING ENGINE VERTICAL INSTALLER.

23-15. Proof-testing the engine vertical installer consists of lifting and suspending the vertical installer and engine sling proof-test weight. Proof-test installer as follows:

a. Locate vertical installer in area in which proof-test anchors have been installed. (Refer to paragraph 23-16 for installation of proof-test anchors.)

b. Install support ring in lowered position. (Refer to paragraph 23-29 and 23-31.)

c. Perform function test. (Refer to paragraph 23-13.)

d. Using turnbuckles provided with proof-test weight, secure installer to proof-test anchors. Where proof-test anchors are not available, installer may be tied down to from 3,250 to 3,750 pounds of counterweights placed on the ground with masses spaced at approximately 90-degree intervals and equidistant from the center of installer. Counterweights must not be placed on top of installer unless blocks or jacks are used to relieve caster overloads.

CAUTION

When the proof-test weight and counterweights are placed on the installer, overloading and subsequent failure of the caster assembly can occur.

e. Place proof-test weight on installer.

f. Remove hoist assembly from proof-test weight and attach to overhead structure or hoist.

g. Move HOIST selector switch to DUAL, and depress HOIST #2 ENGINE DOWN button on remote-control station. Reel out cables, as necessary.

h. Route cables through hoist assembly pulleys and attach to proof-test weight. (See TEST NO. 1 on proof-test weight instruction plate.)

i. Repeat step g, and aline proof-test weight hoist assembly 9026679 directly above installer hoists, 38 ±3 feet above installer.

j. Make sure that cables lie smoothly in grooves of hoist drum and pully sheaves and that a minimum of 1-1/2 cable wraps remain on drum.

WARNING

The hoisted proof-test weight causes extreme strain on the sling. Accelerating or jerking the proof-test weight during lifting, lowering, or while suspended can cause undue strain and possible failure of the sling, resulting in serious injury to personnel and damage to equipment.

k. Depress HOIST #2 ENGINE UP button. Raise proof-test weight approximately 1 ±1/2 inch and suspend for 5 minutes. Proof-test weight must not be tilted. Operate hoists individually to correct tilt of proof-test weight.

l. Using remote-control station, raise and lower proof-test weight in increments of 1/4 inch. Test hoist brakes with proof-test weight suspended by moving remote-control station HOIST selector switch to OFF. Slippage is not allowable, and the brakes must be fail-safe with the power off. Adjust brakes if malfunction occurs (paragraph 23-18).

m. Move remote-control station HOIST selector switch to DUAL to restore power to remote-control station.

n. Depress HOIST #2 ENGINE DOWN button and lower proof-test weight onto installer.

o. Inspect hoists, installer, and remaining parts for structural deformation.

p. Record proof test. A proof-load identification plate (figure 23-1) may be used to record date and verification of proof test.

q. Remove proof-test weight and secure installer.

23-16. INSTALLING PROOF-TEST ANCHORS. Proof-test anchors, supplied with the vertical installer and engine sling proof-test weight, are installed permanently in the facility concrete floor as follows:

a. Lay out a rectangular pattern 89 ±1 by 123 ±1 inches within an area that has sufficient working space for test equipment and handling equipment to perform the test.

NOTE

Concrete anchors must be installed in 2,500 pounds (minimum) of concrete.

- The corners of the rectangular pattern will be directly below the draw bar attach point at each corner of the installer.

b. Drill a 1-3/8 inch diameter hole in concrete 2-13/16 inches deep at each corner of rectangular pattern.

c. Install a threaded cone, 2 plain cones, and a lead sleeve.

d. Using a setting tool or pipe of same diameter as anchor, tap anchor into hole until threaded cone is at bottom of concrete hole.

e. Install turnbuckle assembly anchor bolt into anchor; tighten until anchor is flush with surface.

NOTE

The anchor bolt may be removed, if desired, and reinstalled on turnbuckle assemblies.

23-17. ADJUSTING HOIST ELECTRIC BRAKE. Adjusting the electric brake consists of setting the air gap. See figure 23-7 and proceed as follows:

a. Make sure electrical power is off. Remove electric brake hood.

b. Measure air gap. Gap must not exceed maximum indicated on nameplate.

c. To reduce air gap, remove upper hinge pin, turn spring bolt counterclockwise, insert hinge pin, and check gap. Adjust air gap midway between zero and maximum gap indicated on nameplate. Repeat until proper air gap is obtained.

d. Secure electrical hoist.

23-18. ADJUSTING HOIST LOAD BRAKE. Adjusting the brake consists of an external adjustment and checking brake operation under full load. See figure 23-7 and proceed as follows:

a. Remove load from hoist cable.

b. Loosen locknut and slowly tighten hoist load brake adjusting screw until moderate resistance is felt. Back out adjusting screw a half-turn and tighten locknut.

c. Removing air vent plug located on gear end frame near brake adjustment screw. Observe movement of compound planetary gears when full load is lifted. Movement should be 3/8 ±1/16 inch. Refer to paragraph 23-14 to test brake with load.

23-19. ADJUSTING CASTER BRAKE. Adjusting caster brakes consists of positioning the brakes to apply the required force to the caster wheels without overloading the brake levers. To adjust caster brakes, proceed as follows:

a. Loosen bolt that attaches brake to mounting bracket.

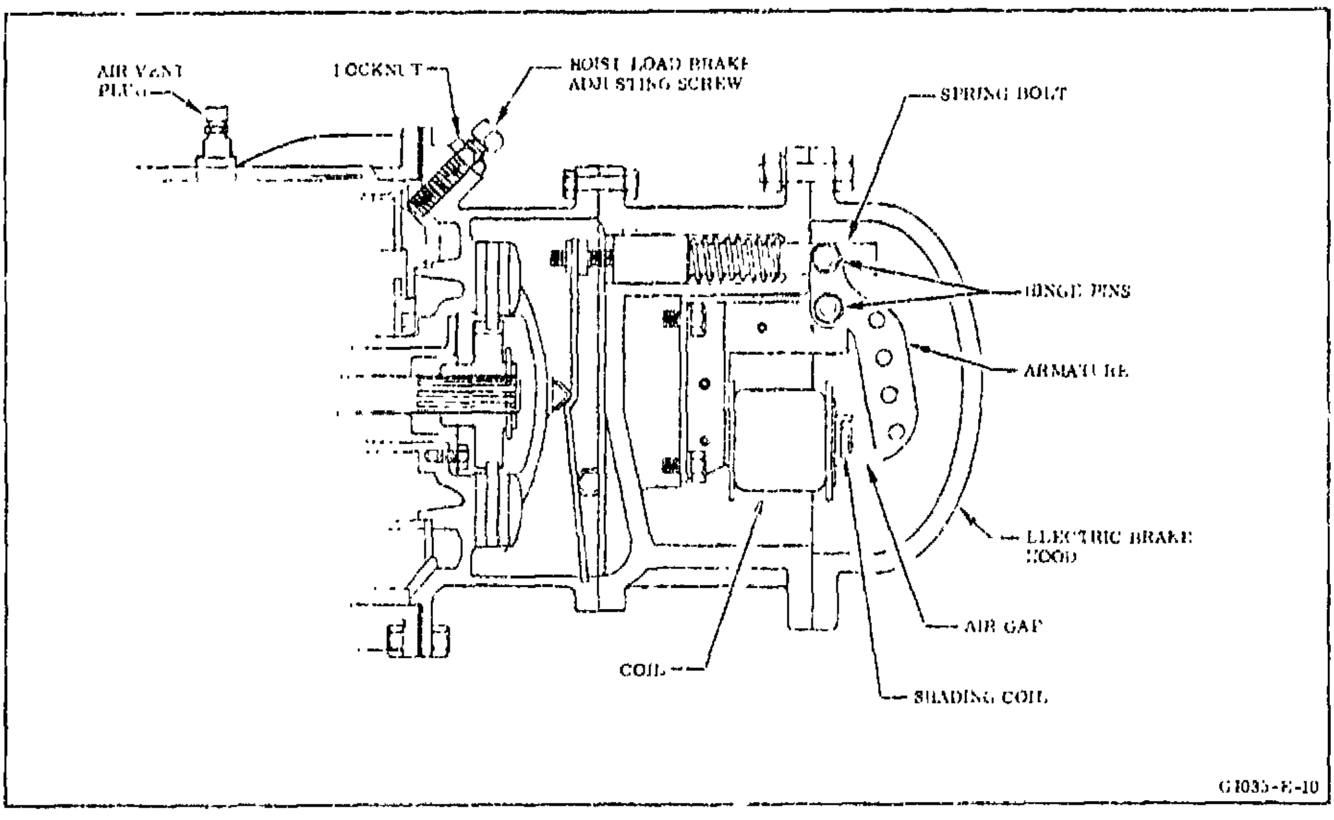



Figure 23-7. Engine Vertical Installer Hoist Brake Adjustment

b. Actuate brake lever until nearly over center and hold. Position brake in serrations allowing brake shoe to touch wheel. Release brake lever.

c. Move brake one serration away from caster wheel and torque bolts. Refer to Torque Values for Nuts, Bolts, and Screws in R-3825-5, Volume I.

23-20. ADJUSTING TILT ALARM SYSTEM. Adjusting the tilt alarm system consists of repositioning the mercury switch in the controller box. See electrical schematic in figure 23-6 and proceed as follows.

a. Remove cover from installer controller box.

NOTE

Two extreme upper boltholes of the controller box cover are threaded, enabling installation of lifting eyes stowed in the installer.

b. Connect 2 lifting slings (3,000-pound capacity each) between tiedown rings on side of installer on which alarm is to be adjusted.

WARNING

The controller box will be energized with high-voltage electrical power. Adjusting switches with electrical power on can cause injury or death to personnel.

c. Connect installer to facility electrical power source capable of supplying 440 vac protected to 35 amps. Turn facility power on.

CAUTION

The side of the installer must not be raised more than 10 inches since damage to equipment can result.

d. Slowly raise side of installer until alarm sounds, measure height, and lower installer.

e. Turn facility electrical power off.

f. In controller box loosen mounting screw and adjust mercury switch that corresponds to side that was raised.

NOTE

Four mercury switches, two on each bracket, correspond to the four respective sides of the installer. Rotating the mercury switch clockwise raises the limit.

g. Turn facility power on and slowly raise side of installer. The alarm must sound when the side is raised 6 ±1 inches. Repeat steps a through g until alarm performs satisfactorily.

h. Secure installer and test equipment.

23-21. LUBRICATING ENGINE VERTICAL INSTALLER. Lubrication of the installer consists of greasing and oiling hoists (casters are permanently lubricated). (See figure 23-8.) To lubricate hoists, proceed as follows:

a. Fill gear end with lubricating oil (MIL-L-6086, Grade L) until oil level reaches top of oil gage. Leave oil gage open 5 minutes after filling. Make sure oil is at correct level.

b. Lubricate (Method X, R-3825-5, Volume I) fittings with gear grease (MIL-G-23827).

c. Reel out and lubricate hoist cables with corrosion preventative RB0210-016 (Rocketdyne), or equivalent.

d. Fill motor-end reduction gear cavity of hoists with lubricating oil (MIL-L-6086, Grade L) to level of oil-level plug. Remove reduction gear cavity vent fitting to fill reduction gear cavity.

## 23-22. PAINTING ENGINE VERTICAL INSTALLER.

WARNING

The following specifies primer (MIL-P-8585), which is flammable and must not be used near heat, sparks, or open flame. It is toxic. Inhalation of its vapors or prolonged contact with the primer can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

23-23. Painting the engine vertical installer consists of touching up exposed or scratched surfaces and stenciling obliterated markings. (Omit paint on support ring cross beams.) Paint requirements are as follows:

a. Base coat: zinc chromate primer (MIL-P-8585).

b. Finish coat: orange-yellow enamel (Federal Specification TT-E-489), color 13538 (Federal Standard 595).

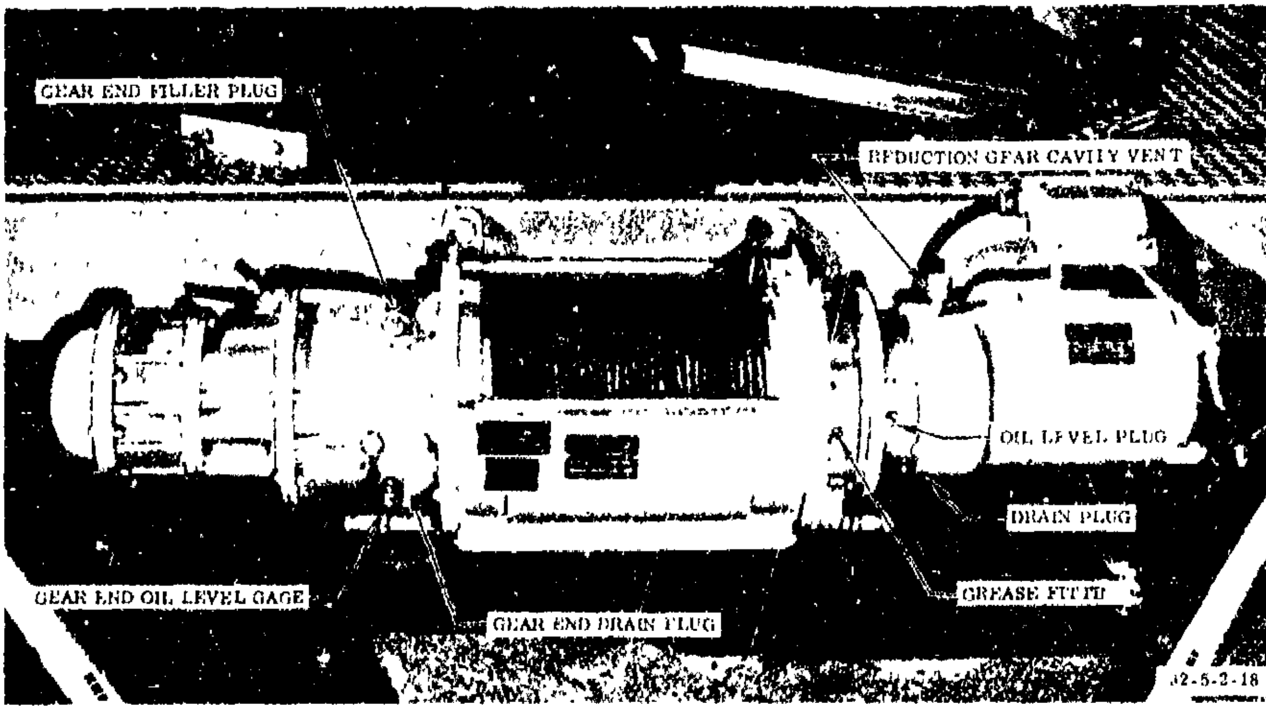



Figure 23-8. Engine Vertical Installer Hoist Lubrication

c. Brackets and pier: red enamel (MIL-E-7729, Type I), color 31136 (Federal Standard 595).

d. Stencil markings on engine vertical installer surfaces and accessories: black lacquer (Federal Specification TT-L-32), color 27038 (Federal Standard 595). Stencil markings on protective cover: orange-yellow lacquer (Federal Specification TT-L-32), color 23538 (Federal Standard 595).

23-24. STORING ENGINE VERTICAL INSTALLER.

a. Lubricate vertical installer (paragraph 23-21).

b. Hand-wipe exterior surfaces. Refer to Cleaning in R-3825-5, Volume I.

c. Detach and stow tow bar on installer.

d. Install installer protective cover.

23-25. MAINTENANCE OF ENGINE VERTICAL INSTALLER COMPONENTS.

23-26. Maintenance of components consists of removing, installing, and replacing installer components. No special instructions are required to remove or install components except those listed in the following paragraphs. Refer to torque values in section I for applicable values when installing a component. Function-test installer (paragraph 23-13) when replacing hoist system.

23-27. REMOVING SUPPORT RING.

a. Attach sling to an overhead hoist and to support ring.

NOTE

The support ring weighs 1,000 pounds.

b. Lift the ring enough to ensure support of ring weight while removing support ring holders.

c. Remove bolts and holders from hanger (figure 23-1).

d. Unscrew brake handle and remove bolts that attach brake to hanger.

e. Raise support ring from installer.

23-28. REPAIRING SUPPORT RING. Repair of the support ring consists of cementing the protective rubber pad to the ring with adhesive EC1300L (Minnesota Mining and Mfg), or equivalent.

23-29. INSTALLING SUPPORT RING.

a. Attach sling to an overhead hoist and to the support ring.

WARNING

Do not place fingers between support ring and frames, since serious injury can result.

b. Lower support ring into frame until groove is alined with holder slots in hangers.

c. Install support ring holders. Torque nuts MS20500 to 170-230 in-lb and nuts MS20500-624 to 70-90 in-lb.

d. Move support ring horizontally until contact is made with the 2 radial bearings in holders; install third support ring holder with attaching hardware.

e. If radial bearing on third support ring holder contacts support ring before holder contacts frame or hanger channel, remove third holder. Disassemble holder, remove one large washer, reassemble, and reinstall holder. Torque center bolt to 15-20 in-lb above drag torque.

f. Torque holder nuts MS20500-820 to 170-230 in-lb and nuts MS20500-624 to 70-90 in-lb.

g. Install support ring brake in brake hanger with brake pad in groove of support ring. Secure brake with attaching hardware. Torque bolts to 400-530 in-lb.

23-30. REMOVING AND INSTALLING SUPPORT RING HOLDER.

a. Attach sling to an overhead hoist and to support ring.

NOTE

The support ring weighs 1,000 pounds.

b. Lift the ring enough to ensure support of ring weight while removing support ring holders.

c. Remove bolts and holders from hanger (figure 23-1).

WARNING

Do not place fingers between support ring and frames, since serious injury can result.

d. Lower support ring into frame until groove is alined with holder slots in hangers.

e. Install support ring holders. Torque nuts MS20500 to 170-230 in-lb and nuts MS20500-624 to 70-90 in-lb.

f. Move support ring horizontally until contact is made with the 2 radial bearings in holders; install third support ring holder with attaching hardware.

g. If radial bearing on third support ring holder contacts support ring before holder contacts frame or hanger channel, remove third holder. Disassemble holder, remove one large washer, reassemble, and install holder. Torque center bolt to 15-20 in-lb above drag torque.

h. Torque holder nuts MS20500-820 to 170-230 in-lb and nuts MS20500-624 to 70-90 in-lb.

23-31. REMOVING AND INSTALLING SUPPORT RING HANGERS. To remove support ring hangers, refer to paragraph 23-27. Remove attaching hardware and hangers (figure 23-1). To install support ring hangers, install hangers and attaching hardware. Torque hanger nuts to 250-350 in-lb. When installing long hangers, attach tie rods. Install support ring. (Refer to paragraph 23-29.)

23-32. REPAIRING SUPPORT RING HANGERS. Repairing the hangers consists of bonding protective pads (rubber extrusion AMS3303C) to hangers with an adhesive. Prepare adhesive by mixing 4.5 parts (by weight) of catalyst A-4000 (Dow Corning Corp), or equivalent, with 100 parts (by weight) of adhesive A-4000 (Dow Corning Corp), or equivalent. Bond pads as follows:

WARNING

The following specifies A-4000, which is flammable and must not be used near heat, sparks, or open flame. Its catalvst may irritate the skin. In case of contact, wash with soap and water.

- The following procedure specifies methyl-ethyl-ketone, which is flammable and must not be used near heat, sparks, or open flame. It is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury.

a. Prepare metal and rubber surfaces by removing foreign matter with emery cloth and cleaning with methyl-ethyl-ketone (Federal Specification TT-M-261), or equivalent. Allow to dry.

WARNING

The following specifies primer A-4014 or A-4094, which is flammable and must not be used near heat, sparks, or open flame. It is toxic. Inhalation of its vapors or prolonged contact with the primer can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

b. Apply primer A-4014 or A-4094 (Dow Corning Corp), or equivalent, to hanger and allow to dry for 30 minutes.

c. Apply uniform film of prepared adhesive, 0.010 to 0.015 inch thick, to pad and hanger. Dry for 30 minutes or until tacky.

WARNING

The following procedure specifies toluene, which is flammable and must not be used near heat, sparks, or open flame. It is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

d. Press pad onto hanger for a few seconds. Remove excessive adhesive with toluene (Federal Specification TT-T-548).

e. Allow to cure a minimum of 24 hours at room temperature. (Maximum strength is obtained when hangers cure for 4 days.) Apply a uniform pressure (tape is a satisfactory means) to area being bonded until adhesive is cured.

23-33. REMOVING AND INSTALLING SUPPORT RING BRAKE.

a. To remove support ring brake, remove support ring. (Refer to paragraph 23-27.)

b. Remove bolts, nuts, and washers that attach brake hanger to frame. Remove brake hanger (figure 23-1).

c. To install support ring brake, install short or long hanger, as required, and bolt, nuts, and washers. Torque nuts to 250-330 in-lb.

d. Install support ring and brake. (Refer to paragraph 23-29.)

23-34. REPAIRING SUPPORT RING BRAKE. Repairing the brake consists of replacing parts and cementing the brake pad to the brake shoe. No special instructions are necessary to replace parts. See figure 23-1 for parts identification. Cement brake shoe (rubber pad AMS3215) to the brake with adhesive 590M (Coast Pro-Seal) as follows:

WARNING

The following procedure specifies methyl-ethyl-ketone, which is flammable and must not be used near heat, sparks, or open flame. It is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

a. Prepare pad and shoe by removing foreign matter with emery cloth and cleaning with a clean cloth moistened with methyl-ethyl-ketone (Federal Specification TT-M-261), or equivalent.

b. Brush thin, even coat on shoe and pad surfaces. Dry cement about 30 minutes until it becomes tacky.

c. Press pad onto shoe, and roll from center to edges with 2-inch-diameter rubber roller to affect firm contact and remove all air bubbles. Remove excess cement with cloth moistened with methyl-ethyl-ketone, or equivalent.

d. Allow to dry. Do not strain cemented joint for 48 hours.

23-35. REMOVING AND INSTALLING HOIST CABLE.

a. Reel out cable to be removed to full length of 79 feet.

b. Remove cable swedged fitting from keyhole slot in drum.

c. Install replacement cable swedged fitting into keyhole slot in drum. Make sure that cable engages slot.

d. Lubricate cable. (Refer to paragraph 23-21.)

e. Reel in, making sure that cable lies smoothly in grooves of drum.

23-36. REPAIRING PROTECTIVE COVER. A repair kit and instructions for repairing the protective cover are included in the installer accessories and are stowed in the installer.

23-37. LUBRICATING BALL-LOCK PINS. Lubricating ball-lock pins consists of removing existing lubricant, cleaning, and lubricating, as follows:

WARNING

The following procedure specifies Stoddard solvent, which is flammable and must not be used near heat, sparks, or open flame. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury.

a. Immerse shank of ball-lock pin in clean Stoddard solvent (Federal Specification P-D-680), and actuate ball-lock pin release until existing lubricant is flushed out.

b. While actuating ball-lock pin release, allow cleaning agent to drain from lockpin. Blow lockpin dry and immediately apply lubricant (step c).

c. Force gear grease (MIL-G-23827) into ball-lock pin at shank end and around ball-locks while actuating ball-lock pin release.

d. Wipe grease from exterior surfaces of ball-lock pin.

23-38. <u>REMOVING AND INSTALLING ELECTRICAL CONTROLLER BOX COVER.</u>

23-39. To remove cover, remove two extreme upper bolts, install lifting eyes into cover, and remove remaining bolts. To install cover, perform the following procedure in a clean, dry area to prevent trapping of excessive moisture in controller box:

a. Inspect unpainted mating surfaces of controller box and cover for a protective coat of grease. If there is no evidence of grease, apply a light coat of lubricant KEL-F 90 (Minnesota Mining and Mfg).

b. Place cover into position on controller box and partially install bolts.

c. Using a 1/4-inch hose, apply a low-pressure (10 psig maximum) purge of gaseous nitrogen (MIL-P-27401) in gap between cover and controller box for 15 minutes. Move purge hose around perimeter of cover and controller box while applying purge.

d. Remove purge. Torque bolts (refer to R-3825-5, Volume I).

WARNING

The following procedure specifies trichloroethylene, which is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

e. Using trichloroethylene (MIL-T-27602), clean a one-inch-wide area on each side of cover mating surface seam, completely around cover. Do not remove paint from surface.

WARNING

The following specifies black sealant RTV-103, which is flammable and must not be used near heat, sparks, or open flame. It is toxic. Inhalation of its vapors or prolonged contact with the sealant can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

f. Apply a 1/8-inch-diameter bead of black sealant RTV-103 (General Electric), or equivalent, on cover mating surface seam. Spread bead out so that it is 1/4 inch on each side of seam and approximately 1/32 inch thick.

23-40. REMOVING AND INSTALLING ELECTRICAL CONTROLLER BOX ELECTRICAL COMPONENTS.

23-41. No special procedures are required for removing and installing electrical components, except the following:

a. Remove controller box cover (paragraph 23-38).

WARNING

The following procedure specifies varnish, which is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

b. Varnish electrical components with a coat of moisture- and fungus-resistant varnish (MIL-V-173) after installation. Do not allow varnish to contact surfaces that affect electrical continuity or operation. Wear eye protection when applying varnish.

c. Install controller box cover (paragraph 23-38).

d. Function-test installer (paragraph 23-13).

23-42. INSPECTING AND REPAIRING ELECTRICAL CONTROLLER BOX.

23-43. Inspecting and repairing the electrical controller box consists of inspecting box and cover for corrosion and applying corrosion preventative materials. This procedure must be performed in a clean. dry area to prevent trapping of excessive moisture and contamination in the controller box.

a. Remove cover from electrical controller box (paragraph 23-38).

b. Inspect electrical components, painted surfaces, and unpainted mating surfaces of box and cover for corrosion. Omit steps c and d, if no corrosion exists.

c. Remove corrosion from electrical components, painted surfaces, and unpainted mating surfaces. Use 400-grit sandpaper to remove corrosion from unpainted mating surfaces. Clean components and surfaces (refer to R-3825-5, Volume I).

WARNING

The following specifies primer (MIL-P-8585), which is flammable and must not be used near heat, sparks, or open flame. It is toxic. Inhalation of its vapors or prolonged contact with the primer can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

d. Apply a coat of zinc chromate primer (MIL-P-8585) to exposed painted surfaces where corrosion was removed.

WARNING

The following procedure specifies varnish, which is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

e. Inspect electrical components for a protective coat of varnish. If exposed surfaces exist or corrosion was removed, apply a coat of moisture- and fungus-resistant varnish (MIL-V-173) to electrical components. Do not allow varnish to contact surfaces that affect electrical continuity or operation. Wear eye protection when applying varnish.

f. Install electrical controller box cover (paragraph 23-38).

g. Function-test installer (paragraph 23-13) if varnish was applied to electrical components.

# SECTION XXIV

# TURBOPUMP MAINTENANCE STANDS

WARNING

FUEL TURBOPUMP MAINTENANCE STAND G4061 AND OXIDIZER TURBOPUMP MAINTENANCE STAND G4062 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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## 24-1. DESCRIPTION AND LEADING PARTICULARS OF FUEL TURBOPUMP MAINTENANCE STAND G4061.

24-2. The fuel turbopump maintenance stand (figure 24-1) is designed both to hold the turbopump securely and to rotate it for convenient assembly and disassembly. The stand consists of a caster-mounted, steel base with a trunnion-mounted rotating frame. The casters are equipped with 8-inch wheels, swivel locks, and foot brakes. The rotating frame is equipped with locator brackets, a yoke, and a lockpin for attaching the turbopump. Power from a manually operated wheel crank is transmitted through a gear reductor, coupling, and driveshaft to the rotating frame which rotates the turbopump. Forklift guides, forming an integral part of the stand base, provide for lifting the stand with or without the turbopump. A plastic cover, for security and protection of the turbopump, is stowed in the stowage compartment within the stand. The maintenance stand has a work-load capacity of 390 pounds and is proof-tested to 780 pounds.

## 24-3. CONFIGURATION CHANGE--MANUAL EFFECTIVITY.

24-4. The modification incorporated changing configuration of the fuel turbopump maintenance stand is listed in figure 24-2.

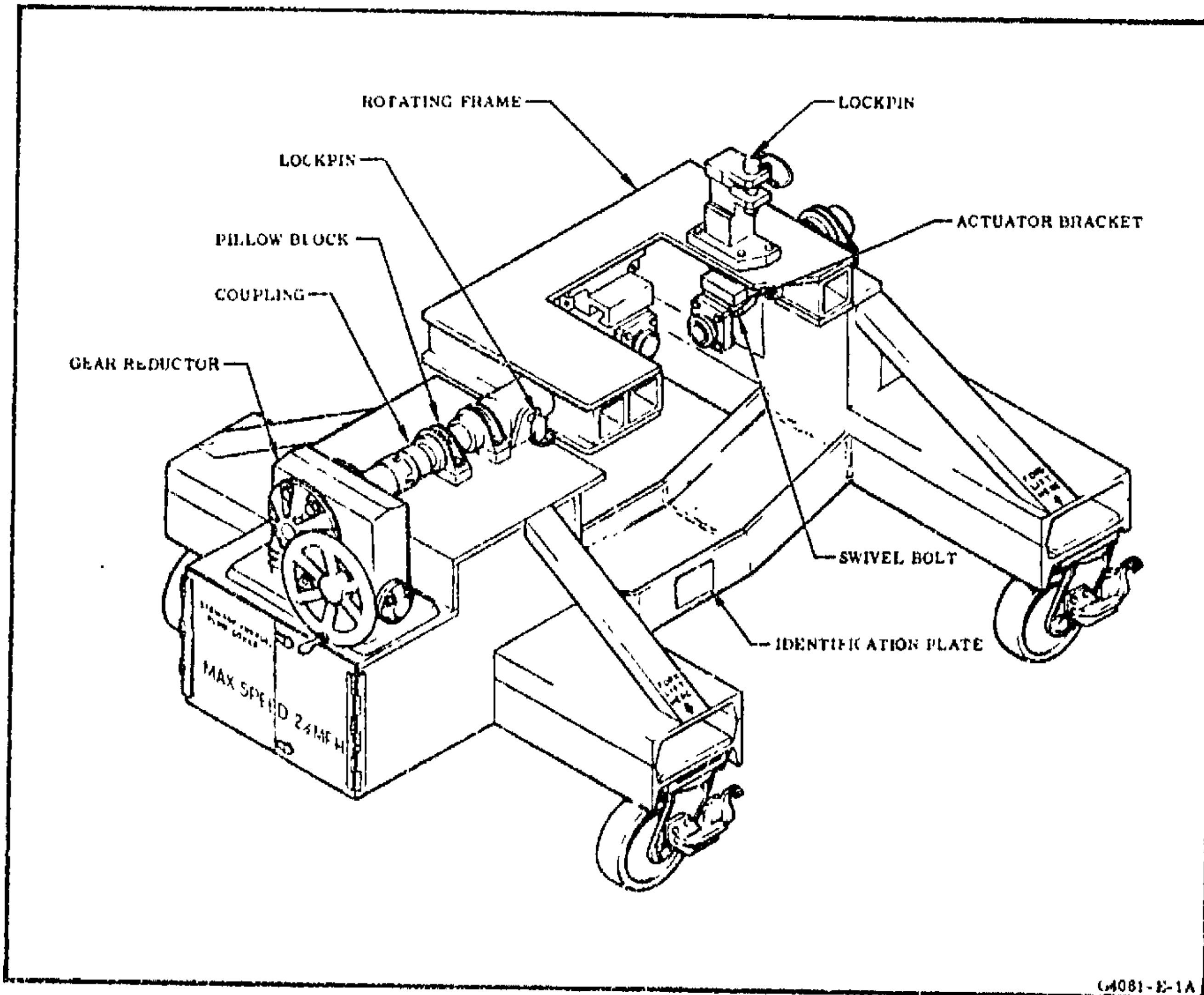


Figure 24-1. Fuel Turbopump Maintenance Stand

| Approved ECP Number | MD Number | Incorporated In Manual Dated |
|---|---|---|
| J2-411 | 1 | N/A |

Figure 24-2. Configuration Change - Manual Effectivity

## 24-5. DESCRIPTION AND LEADING PARTICULARS OF OXIDIZER TURBOPUMP MAINTENANCE STAND G4062.

24-6. The oxidizer turbopump maintenance stand (figure 24-3) is designed both to hold the turbopump securely and to rotate it for convenient assembly and disassembly. The stand consists of a caster-mounted, steel frame and a trunnion-mounted yoke, equipped with locator and swivel pins for securely attaching and supporting the turbopump housing. The yoke permits the turbopump to rotate by means of a manually cranked worm gear reductor and driveshaft. The yoke, gear reductor, and driveshaft are mounted on a structural steel base and are supported by 4 casters equipped with 8-inch wheels, swivel locks, and foot brakes. Forklift guides in the stand base lift the stand with or without the turbopump. A plastic cover, for security and protection of the turbopump, is stowed in a compartment within the stand. On maintenance stands incorporating MD1 change, the yoke is modified to eliminate interference with the turbopump. The stand has a workload capacity of 335 pounds, and is proof-tested to 670 pounds.

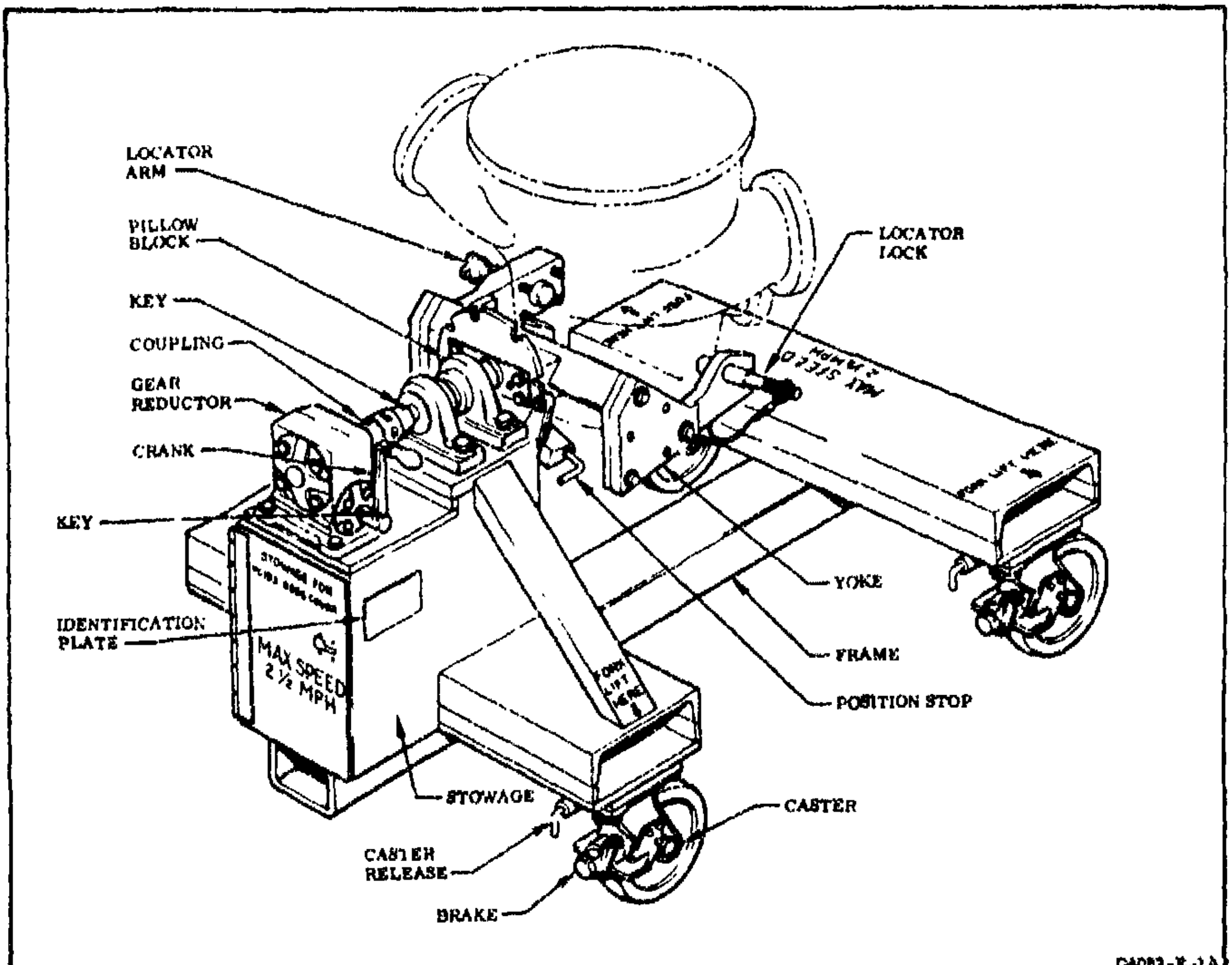


Figure 24-3. Oxidizer Turbopump Maintenance Stand

| Approved ECP Number | MD Number | Incorporated In Manual Dated |
|---|---|---|
| J2-353 | 1 | N/A |

Figure 24-4. Configuration Change--Manual Effectivity

24-7. CONFIGURATION CHANGE--MANUAL EFFECTIVITY.

24-8. The modification incorporated changing configuration of the oxidizer turbopump maintenance stand is listed in figure 24-4.

24-9. MAINTENANCE OF TURBOPUMP MAINTENANCE STANDS.

24-10. Maintenance tasks required on the stands are listed in figure 24-5. Information presented lists the tasks to be performed, when they shall be performed, and where data support is found.

24-11. ADJUSTING TURBOPUMP MAINTENANCE STAND BRAKES.

24-12. Adjusting brakes consists of positioning each brake to apply the required force, without overloading the brake lever, as follows:

a. With brake lever fully up, push brake shoe toward brake housing as far as possible.

b. Loosen bolts attaching brake to mounting bracket, and position brake to obtain a clearance of 7/16 (+0, -1/16) inch between brake shoe and tire.

c. Secure brake to mounting bracket and torque nuts. Refer to Torque Values for Threaded Fasteners in section I.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect rotating assembly for: | X | X | | | |
| Damaged or missing lockpins. | | | | | Replace lockpins. |
| Loose or missing bolts. | | | | | Replace or tighten bolts. Refer to section I for torque values. |
| Inoperative position stop. | | | | | Replace stop. |
| Distorted or worn coupling. | | | | | Replace coupling. |
| Lubricate pillow blocks. | | | | X | Every 12 months. Use grease (MIL-G-23872). |
| Inspect reductor for: | X | X | | | |
| Binding or inoperative gears. | | | | | Replace reductor. |
| Loose or missing bolts. | | | | | Replace or tighten bolts. Refer to section I for torque values. |
| Damaged or loose crank handle, shaft key, or setscrew. | | | | | Replace or tighten parts. Refer to section I for torque values. |
| Inspect gearcase oil level. | | | | X | Every 12 months. Maintain oil to level indicated on gear case. Use 600W cylinder oil (Mobil Oil Co). |
| Inspect structural frame for: | X | X | | | |
| Cracked welds. | | | | | Replace maintenance stand. |
| Damaged painted surfaces. | | | | | Paint with orange-yellow enamel (MIL-E-7729, Type I), color 13538 (Federal Standard 595). |

Figure 24-5. Maintenance Requirements (Sheet 1 of 2)

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Obliterated identification plates. | | | | | Paint with black lacquer (Federal Specification TT-L-32), color 17038 (Federal Standard 595). |
| Inspect casters for: | X | X | | | |
| Loose mounting bolts. | | | | | Tighten bolts. Refer to section I for torque values. |
| Broken or binding swival locks. | | | | | Replace locks. |
| Damaged wheels. | | | | | Replace wheels. |
| Inoperative brakes. | | | | | Adjust brakes. Refer to paragraph 24-11. |
| Inspect stowage compartment for damaged doors, hinges, or locks. | X | X | | | Replace parts. |
| Inspect protective cover for tears, ripped seams, or damaged straps. | X | X | | | Replace cover. |
| Clean maintenance stands. | | | | X | Refer to section I for cleaning procedures. |
| Inspect maintenance stand for upright position. | | | | X | During shipping or storage. Maintenance stand must remain upright to prevent loss of oil through gearcase vent plug. |

Figure 24-5. Maintenance Requirements (Sheet 2 of 2)

# SECTION XXV

# TURBOPUMP MAINTENANCE SETS

WARNING

**OXIDIZER TURBOPUMP MAINTENANCE SET 9020798-11 AND FUEL TURBOPUMP MAINTENANCE SET 9020799-31 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.**

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| Basic | -11 | -21 | -31 | Part Number | Set and Kit Nomenclature |
|---|---|---|---|---|---|
| X | | | | 9020798 | OXIDIZER TURBOPUMP MAINTENANCE SET |
| | X | | | 9020798-11 | |
| | x | | | 9021803 | Shaft countertorque wrench kit |
| | x | | | 9021806 | Turbine wheel separator tool kit |
| | x | | | 9021816 | Bearing nut torque wrench kit |
| x | x | | | 9022278 | Oxidizer turbine stationary blade stacking fixture kit |
| x | | | | 9022279 | Oxidizer turbine accessory drive spline wrench kit |
| x | x | | | 9022280 | Oxidizer turbopump inducer bolt spanner wrench kit |
| x | x | | | 9022281 | Oxidizer turbopump inner and outer impeller seal puller kit |
| x | x | | | 9022282 | Oxidizer turbopump inner impeller seal retaining nut spanner wrench kit |
| x | x | | | 9022283 | Oxidizer turbopump carrier seal adapter kit |
| x | x | | | 9022285 | Oxidizer turbopump outer impeller seal retainer nut spanner wrench kit |
| x | x | | | 9022289 | Oxidizer turbine disk removal guide pin kit |
| X | | | | 9020799 | FUEL TURBOPUMP MAINTENANCE SET |
| | X | | | 9020799-11 | |
| | | X | | 9020799-21 | |
| | | | X | 9020799-31 | |
| | x | x | x | 9019356 | Fuel turbopump turbine wheel removal tool kit |
| | | | x | 9021807 | Turbine seal pilot kit |
| | | | x | 9021808 | Stud torquing tool kit |
| | | | x | 9021809 | First-stage turbine wheel gage kit |
| x | x | x | x | 9022276 | Fuel turbine stationary blade stacking fixture kit |
| x | x | x | x | 9022277 | Fuel turbine disk removal guide pin kit |
| x | x | | | 9022284 | Fuel turbopump shaft curvic wrench kit |
| | x | x | x | 9022284-11 | Fuel turbopump shaft curvic wrench kit |
| | | x | x | 9022284-21 | Fuel turbopump shaft curvic wrench kit |
| x | | | | 9022286 | Fuel turbopump spacer and mating ring seal puller kit |
| | x | x | x | 9022286-11 | Fuel turbopump spacer and mating ring seal puller kit |
| x | x | x | x | 9022287 | Fuel turbopump seal nut spanner wrench kit |

Figure 25-1. Turbopump Maintenance Sets

25-1. DESCRIPTION AND LEADING PARTICULARS OF TURBOPUMP MAINTENANCE SETS.

25-2. The oxidizer turbopump and fuel turbopump maintenance sets each consist of a number of kits which provide the special tools required to disassemble and reassemble the respective turbopump to replace seals. Oxidizer turbopump maintenance set 9020798 consists of eight kits. Oxidizer turbopump maintenance set 9020798-11 consists of 10 kits. Fuel turbopump maintenance set 9020799 consists of five kits. Fuel turbopump maintenance sets 9020799-11 and 9020799-21 each consist of seven kits. Fuel turbopump maintenance set 9020799-31 consists of 10 kits. See figure 25-1 for a list of the kits contained in each basic and dash-numbered set.

25-3. CONFIGURATION CHANGES--MANUAL EFFECTIVITY.

25-4. Modifications incorporated in this manual that change the configuration of the turbopump maintenance sets are listed in figure 25-2.

| Approved ECP No. | Part Number | Incorporated into Manual Dated |
|---|---|---|
| J2-450 | 9020799-11 | 3 May 1966 |
| J2-503 | 9020799-21 | 7 September 1966 |
| J2-573 | 9020798-11 | 7 November 1968 |
| J2-574 | 9020799-31 | 7 November 1968 |

Figure 25-2. Configuration Changes--Manual Effectivity

25-5. DESCRIPTION AND LEADING PARTICULARS OF OXIDIZER TURBOPUMP MAINTENANCE SETS 9020798 AND 9020798-11.

25-6. CONFIGURATION CHANGES. Oxidizer turbopump maintenance set 9020798-11 is the same as set 9020798 except for the addition of shaft countertorque wrench kit 9021803, turbine wheel separator tool kit 9021806, and bearing nut torque wrench kit 9021816, and the deletion of oxidizer turbine accessory drive spline wrench kit 9022279. (See figure 25-1.) Instructions for the use of the maintenance set are in R-3825-3.

25-7. SHAFT COUNTERTORQUE WRENCH KIT 9021803. The wrench kit consists of a container, turbine shaft countertorque wrench 9021823, bar 9021824, retainer 9021825, two nuts AN316C6R, two washers LD153-0010-0014, and two setscrews 28707-4C-6. The wrench, bar, and retainer assemble together with the setscrews, nuts, and washers to hold the pump rotor assembly by engaging the turbine accessory drive adapter attach boltheads when torquing the inducer bolt or shaft bearing nut with the turbine wheels installed. (See figure 25-3, view A.)

25-8. TURBINE WHEEL SEPARATOR TOOL KIT 9021806. The toolkit consists of a container, bolt assembly 9021810, plate 9021814, base 9021815, three push rods 9021813, three studs 9021812, three push rod locks 9021811-3, three stud locks 9021811-5, three wingnuts C5947-4-5/16-18, and three washers LD153-0010-0012. The kit provides the tools for separating the first and second stage turbine wheels after hot fire if an interference fit exists between mating curvics. (See figure 25-3, view B.)

25-9. BEARING NUT TORQUE WRENCH KIT 9021816. The wrench kit consists of a container and bearing nut torque wrench 9021817. The wrench is a 4-inch diameter, 7-1/2 inch long steel socket wrench with a Teflon insert and is used to torque the bearing nut during inspection of the turbopump. (See figure 25-3, view C.)

25-10. OXIDIZER TURBINE STATIONARY BLADE STACKING FIXTURE KIT 9022278. The fixture kit consists of a container and support ring 9022288. The ring, approximately 17 inches in diameter and chamfered on one outer edge, supports the individual stationary turbine blades being stacked for clamping. (See figure 25-3, view D.)

25-11. OXIDIZER TURBINE ACCESSORY DRIVE SPLINE WRENCH KIT 9022279. This wrench kit consists of a container and spline wrench 9022292. The 2-3/4 inch spline wrench, with splines machined to match turbine accessory drive adapter splines, countertorques the inducer bolt. (See figure 25-3, view E.)

25-12. OXIDIZER TURBOPUMP INDUCER BOLT SPANNER WRENCH KIT 9022280. This wrench kit consists of a container and spanner wrench 9022293. The spanner wrench, a socket with five equally spaced lugs, removes and installs the inducer bolt. A hexagonal wrenching surface adapts the wrench to standard tools. (See figure 25-3, view F.)

25-13. OXIDIZER TURBOPUMP INNER AND OUTER IMPELLER SEAL PULLER KIT 9022281. The puller kit consists of a container, guide ring assembly 9022294, outer seal puller spacer 9022297, two outer seal studs 9022296, three inner seal studs 9022295, and five washers with nuts. The tools pull the impeller outlet seal from the volute and the impeller inlet seal from the carrier. The guide ring assembly is a metal plate, 12 inches in diameter, with four slots on the inner circumference. The outer spacer is a metal sleeve that is 5 inches high and 11 inches in diameter. (See figure 25-3, view G.)

25-14. OXIDIZER TURBOPUMP INNER IMPELLER SEAL RETAINING NUT SPANNER WRENCH KIT 9022282. This wrench kit consists of a container, retainer 9022299, spanner wrench 9022298, and two bolts with washers. The spanner wrench and retainer remove and install the oxidizer impeller outlet seal nut. The spanner wrench, a socket with six equally spaced lugs, incorporates a hexagonal wrenching surface to adapt it to standard tools. The retainer, a 13-inch metal bar with a protective gasket and bolthole at each end, incorporates a threaded center hole to fit the spanner wrench. (See figure 25-3, view H.)

25-15. OXIDIZER TURBOPUMP CARRIER SEAL ADAPTER KIT 9022283. The adapter kit consists of a container, adapter 9022300, and 10 bolts with washers. The tools support the carrier during installation and removal of the nut and seal. The adapter, approximately 11 inches in diameter, consists of a metal ring and plate mounted on a spacer separating them from a base. There are eight equally spaced holes in the ring, a threaded center plate hole in the plate, and 10 equally spaced holes through the ring plate. (See figure 25-3, view I.)

25-16. OXIDIZER TURBOPUMP OUTER IMPELLER SEAL RETAINER NUT SPANNER WRENCH KIT 9022285. This wrench kit consists of a container, spanner wrench 9022301, and retainer bolt 9022302. The spanner wrench and retainer bolt remove and install the oxidizer impeller inlet seal nut. The spanner wrench, a metal plate with six equally spaced lugs, is approximately 10 inches in diameter with directional references etched on it. A hexagonal wrenching surface adapts the wrench to standard tools. The retainer bolt is 3/4 inch in diameter and approximately 7 inches long. (See figure 25-3, view J.)

25-17. OXIDIZER TURBINE DISK REMOVAL GUIDE PIN KIT 9022289. The guide pin kit consists of a container, two guide pins 9022291, two ball-lock pins NAS1335C2C20K, and two ball-lock pins SL-19212. The 3/8-inch guide pins, approximately 4 inches long, guide the mating and demating of the curvic couplings on the oxidizer turbine rotors and the turbopump shaft. Each pin incorporates an internal wrenching surface. Ball-lock pins SL-19212 are used in handling the first stage oxidizer turbine rotor wheel; the other pins handle the second stage. (See figure 25-3, view K.)

25-18. DESCRIPTION AND LEADING PARTICULARS OF FUEL TURBOPUMP MAINTENANCE SET 9020799, -11, -21, AND -31.

25-19. CONFIGURATION CHANGES. Fuel turbopump maintenance set 9020799-11 is the same as set 9020799, except for the addition of fuel turbopump turbine wheel removal tool kit 9019356 and fuel turbopump shaft curvic wrench kit 9022284-11, and the modification and reidentification of fuel turbopump spacer and mating ring seal puller kit from 9022286 to 9022286-11. Fuel turbopump maintenance set 9020799-21 is the same as set 9020799-11, except that fuel turbopump shaft curvic wrench kit 9022284 is modified and reidentified 9022284-21. Fuel turbopump maintenance set 9020799-31 is the same as set 9020799-21 except for the addition of turbine seal pilot kit 9021807, fuel turbine stud torquing tool kit 9021808, and first stage turbine wheel gage kit 9021809. (See figure 25-1.) Instructions for the use of the maintenance set are in R-3825-3.

25-20. FUEL TURBOPUMP TURBINE WHEEL REMOVAL TOOL KIT 9019356. The toolkit consists of a container, turbine wheel puller 9019358, turbine wheel adapter 9019357, and screws NAS1351C4-16. The puller is a screw device used to apply an axial load to remove and install the turbine wheel from the mounting studs. The adapter, a matched set of semicircular adapters attached with two screws, is used to grip the turbine wheels during removal, handling, and installation. (See figure 25-4, view A.)

25-21. TURBINE SEAL PILOT KIT 9021807. The pilot kit consists of a container and seal pilot 9021822. The seal pilot is a 2-inch-high ring approximately 3-3/4 inches in diameter with a tapered lip on one end. The seal pilot guides the turbine seal onto the turbine ring during installation. (See figure 25-4, view B.)

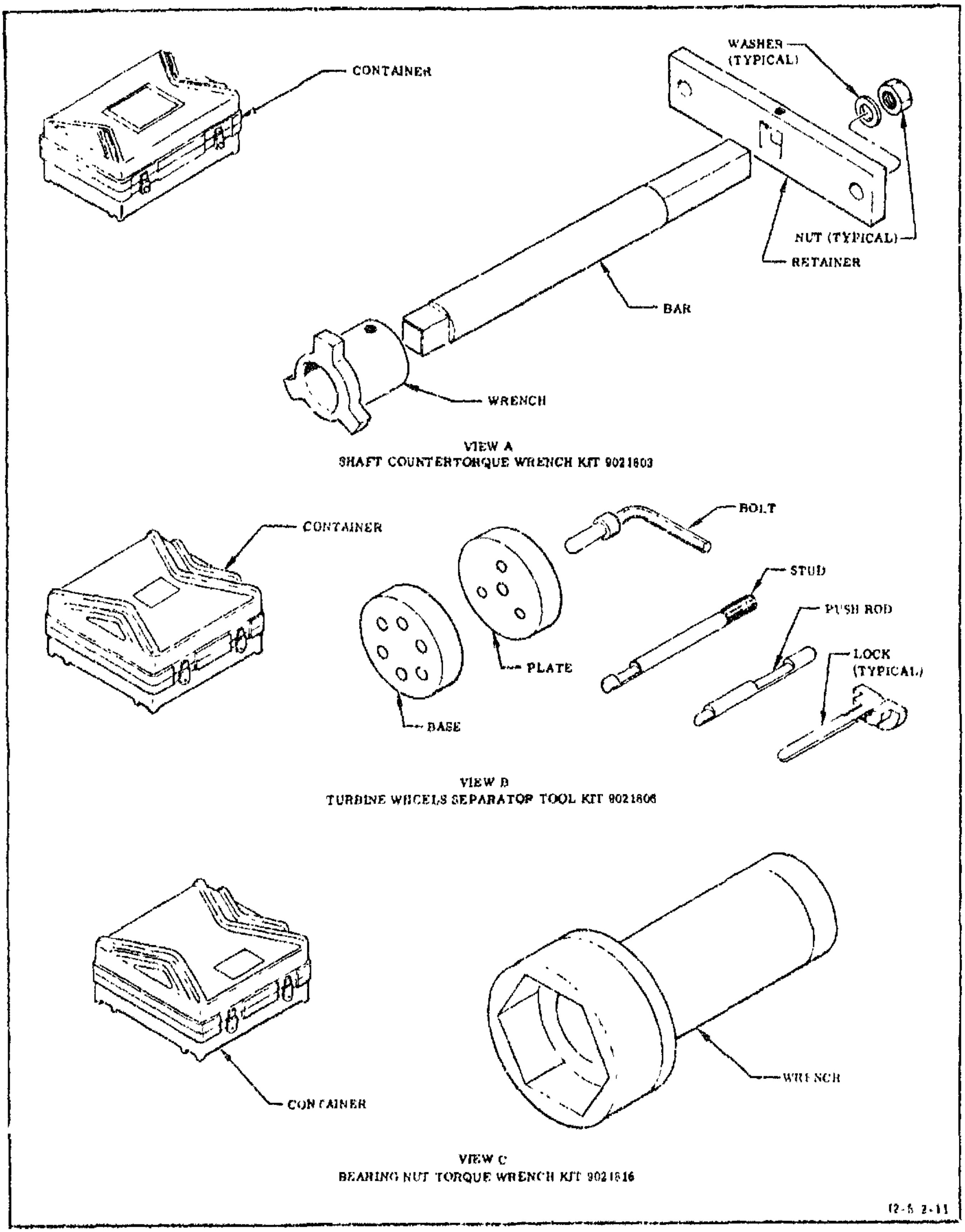
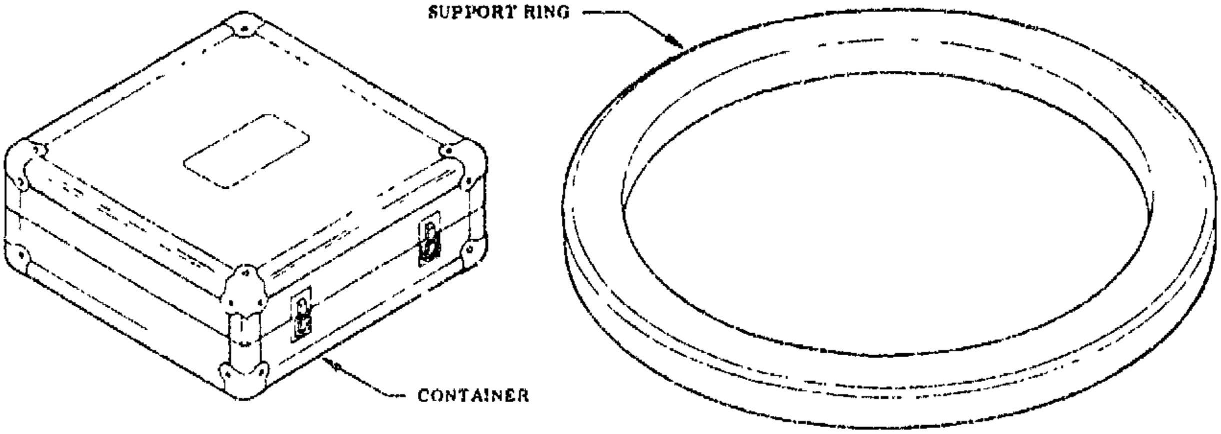
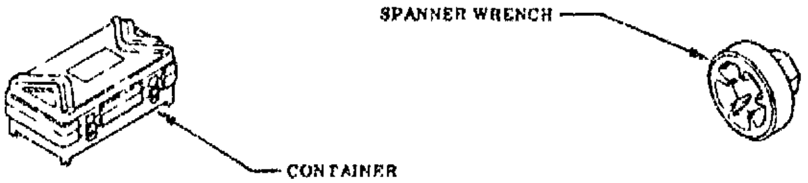



Figure 25-3. Oxidizer Turbopump Maintenance Set (Sheet 1 of 4)




VIEW D
OXIDIZER TURBINE STATIONARY BLADE STACKING FIXTURE KIT 9022278

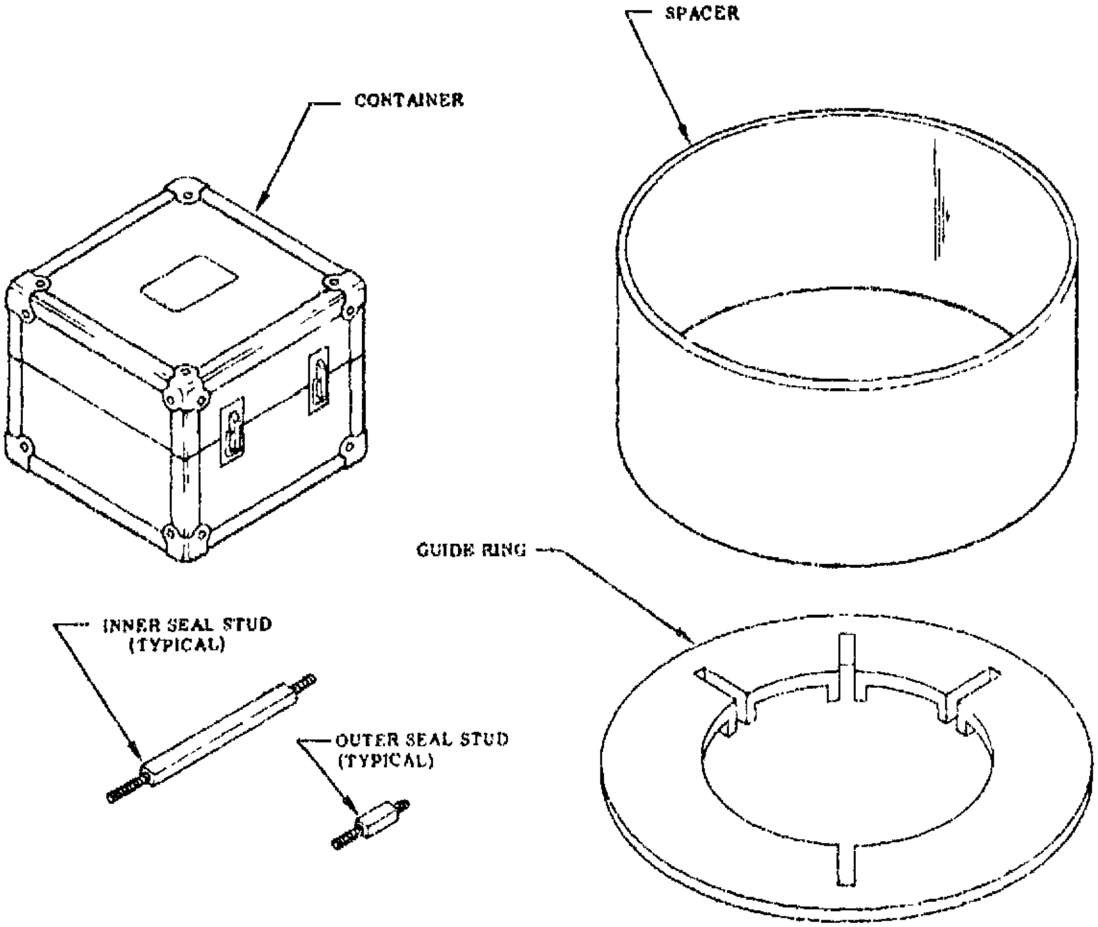

VIEW E
OXIDIZER TURBINE ACCESSORY DRIVE SPLINE WRENCH KIT 9022279



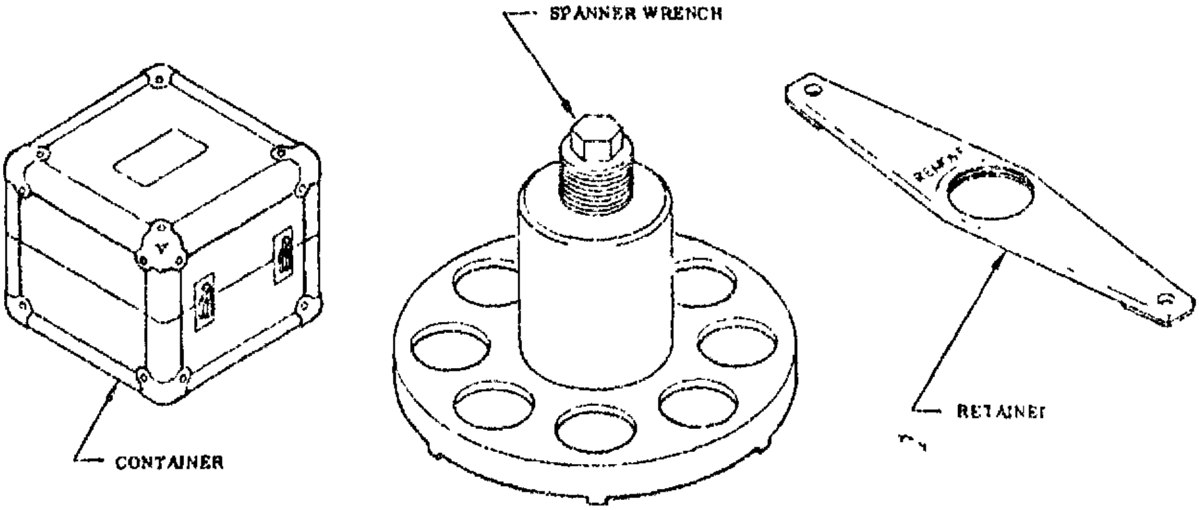

VIEW F
OXIDIZER TURBOPUMP INDUCER BOLT SPANNER WRENCH KIT 9022280

J2-5-2-12

Figure 25-3. Oxidizer Turbopump Maintenance Set (Sheet 2 of 4)




VIEW G
OXIDIZER TURBOPUMP INNER AND OUTER IMPELLER SEAL PULLER KIT 9022281




VIEW H
OXIDIZER TURBOPUMP INNER IMPELLER SEAL RETAINING NUT SPANNER WRENCH KIT 9022282

.2 5-2-13

Figure 25-3. Oxidizer Turbopump Maintenance Set (Sheet 3 of 4)

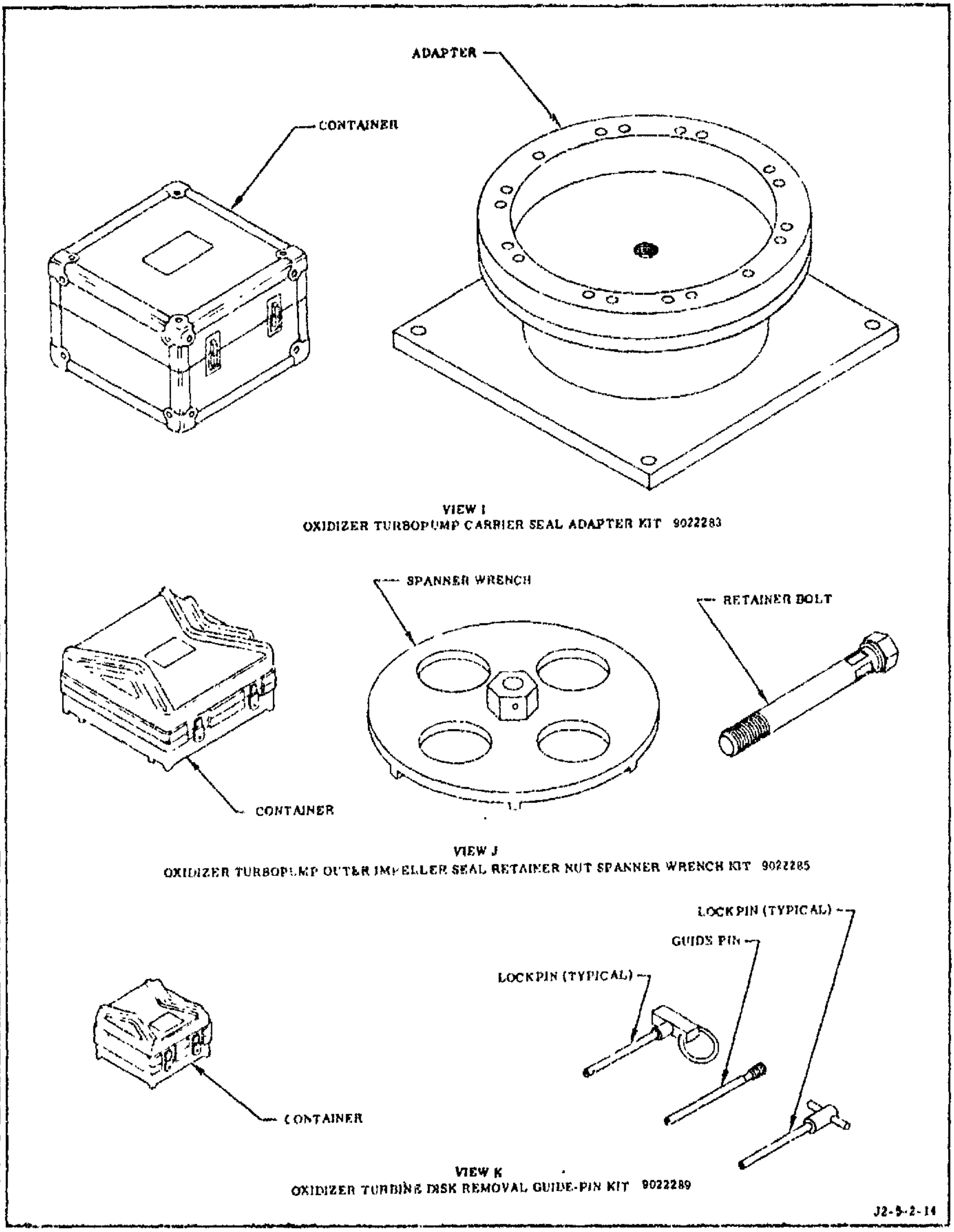



Figure 25-3. Oxidizer Turbopump Maintenance Set (Sheet 4 of 4)

25-22. STUD TORQUING TOOL KIT 9021808. The toolkit consists of a container, torque wrench 9021821, check tool 9021820, and socket M-407. The socket holds the turbine wheel studs during torquing of the nuts with the torque wrench, to stretch the studs to the required dimension. The check tool is an assembly consisting of a plate 9021818, three legs 9021819, and three locking nuts RD114-1002-0004, and is used as a reference surface to check elongation of the turbine wheel studs. (See figure 25-4, view C.)

25-23. FIRST-STAGE TURBINE WHEEL GAGE KIT 9021809. The gage kit consists of a container and the first-stage turbine wheel gage 88-460088, two bolts AN4-6A, and two washers LD153-0010-0010. The gage assembly consists of a plate supporting a triangular slide. The bolts (and washers) secure the gage to the turbine exhaust manifold. (See figure 25-4, view D.)

25-24. FUEL TURBINE STATIONARY BLADE STACKING FIXTURE KIT 9022276. The fixture kit consists of a container and support ring 9022303. The support ring, approximately 13 inches in diameter and chamfered on one outer edge, supports the individual stationary turbine blades being stacked for clamping. (See figure 25-4, view E.)

25-25. FUEL TURBINE DISK REMOVAL GUIDE PIN KIT 9022277. The guide pin kit consists of a container, two guide pins 9022290, and two ball-lock pins SL-19212. The partially threaded, 3/8-inch guide pins, approximately four inches long, guide the mating and demating of the curvic couplings on the fuel turbine rotors and turbopump shaft. Each pin incorporates an internal wrenching surface. The ball-lock pins are used in handling the disks. (See figure 25-4, view F.)

25-26. FUEL TURBOPUMP SHAFT CURVIC WRENCH KIT 9022284, -11, AND -21. The wrench kit 9022284 consists of a container, coupling-shaft curvic wrench 9022306, and six bolts RD111-3003-7516. The curvic wrench, bolted to the end of the fuel pump rotor shaft, countertorques the primary seal nut. The curvic wrench is a spanner wrench 2-1/4 inches in diameter, with 18 teeth, six equally spaced holes, and a square center hole. Kit 9022284-11 is the same as kit 9022284, except that the stud drive shaft wrench 9019365, utilizing new bolts 9019366, replaces the coupling shaft curvic wrench and bolts. Kit 9022284-21 is the same as kit 9022284, except that the coupling-shaft curvic wrench in the modified kit has a smaller outside diameter and is identified as 9022306-3. Bolts RD111-3003-7513 replace bolts RD111-3003-7516 and bolts RD111-3003-7537 are added to aid installation and removal of the turbine. (See figure 25-4, view G.)

25-27. FUEL TURBOPUMP SPACER AND MATING RING SEAL PULLER KIT 9022286 AND 9022286-11. The puller kit consists of a container, puller 9022309, and two each of puller spacer adapters 9022318 and 9025394. The tools pull the primary seal mating ring and spacer from the shaft. The puller, a slotted cylinder with an external clamp for compression, incorporates a thrust bearing and bolt along the centerline of the cylinder. The adapters are semicircular rings, each with a chamfered outer edge. In kit 9022286-11, the guide on puller 9022309-11 was changed and positioning stud 9019368 was added to eliminate any possibility of damage to the close-tolerance drive holes during use of the kit. (See figure 25-4, view H.)

25-28. FUEL TURBOPUMP SEAL NUT SPANNER WRENCH KIT 9022287. This wrench kit consists of a container, spanner wrench 9022307, and retainer 9022308. The spanner wrench and retainer remove and install the primary seal nut. The three-inch-spanner wrench, with 11 equally spaced lugs, incorporates a hexagonal wrenching surface to adapt it to standard tools. The retainer, with a threaded center hole to adapt it to the spanner wrench, is a 17-1/4 inch metal bar with directional references etched on it. Two bolts and washers to attach the retainer are contained in the kit. (See figure 25-4, view I.)

25-29. <u>MAINTENANCE AND REPAIR OF TURBOPUMP MAINTENANCE SETS.</u>

25-30. Maintenance tasks required on turbopump maintenance sets and kits are listed in figure 25-5. Information presented lists the tasks to be performed, when they are to be performed, and reference paragraphs.

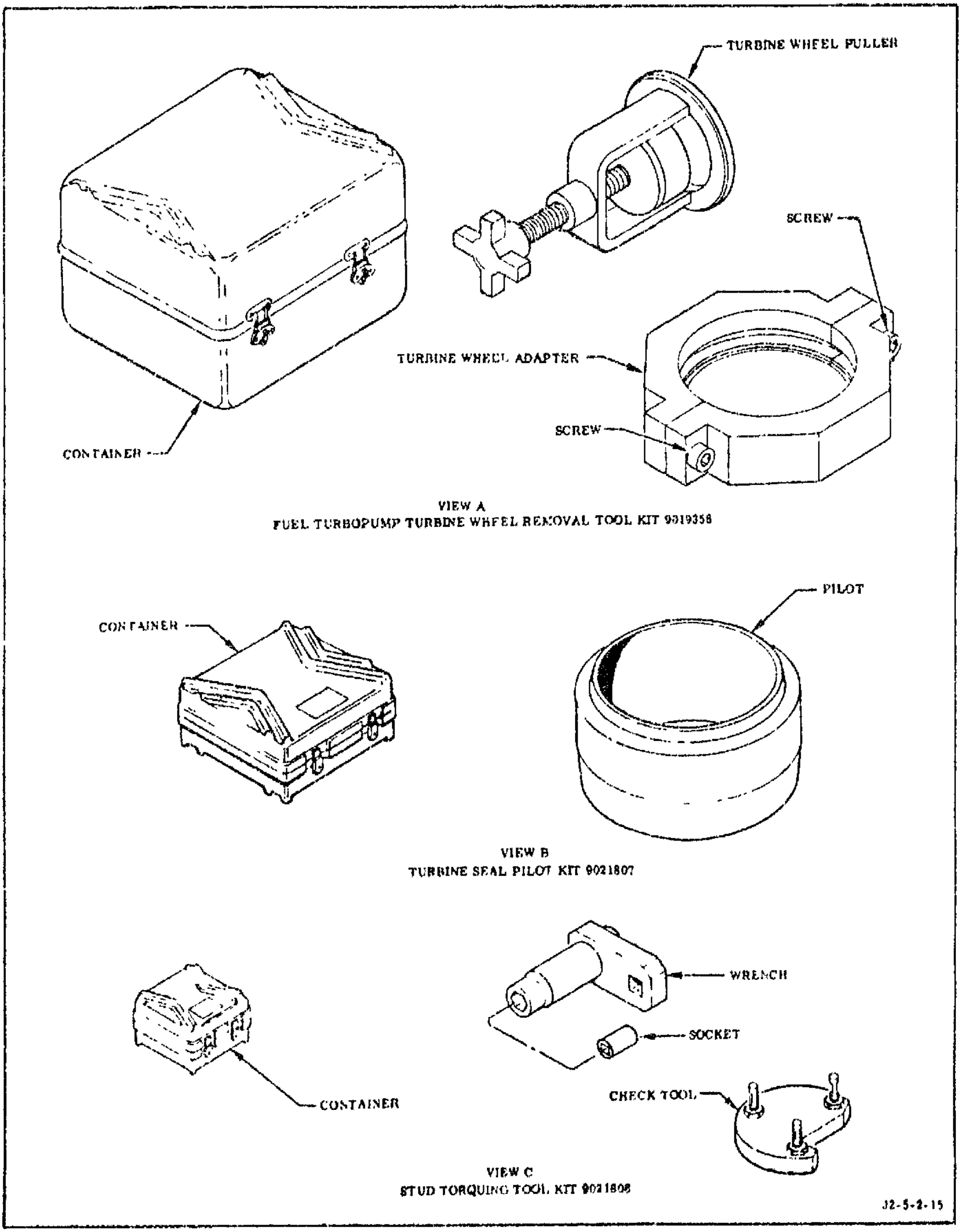
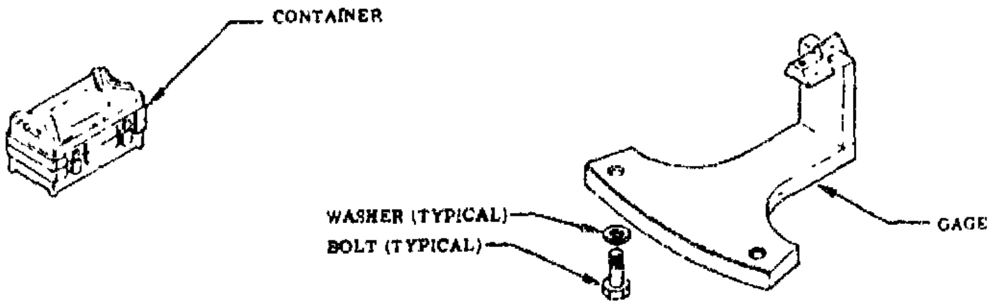
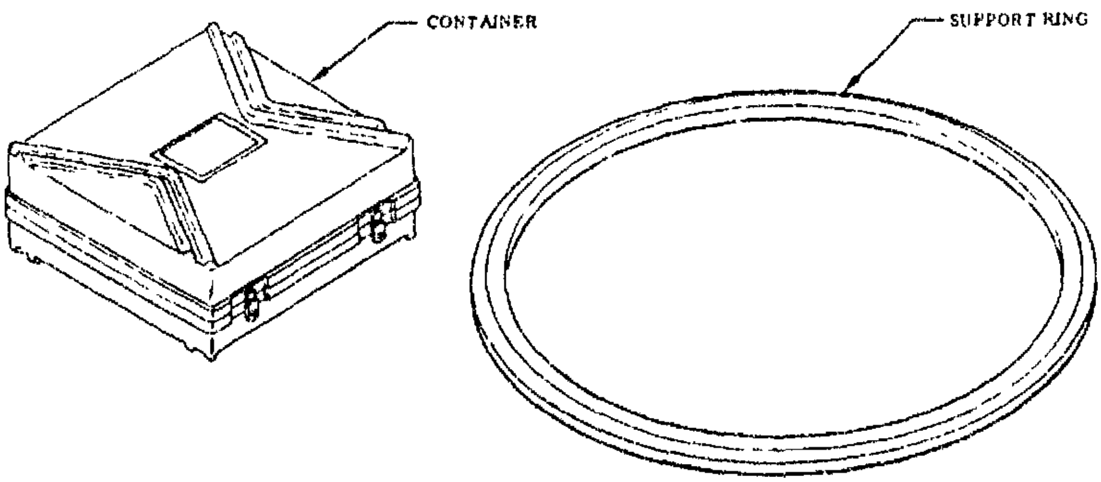


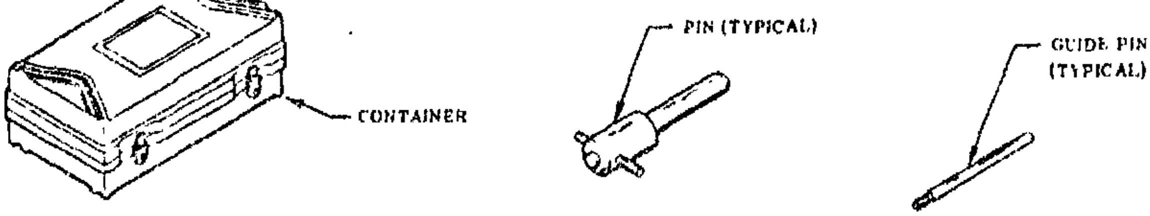

Figure 25-4. Fuel Turbopump Maintenance Set (Sheet 1 of 3)




VIEW D
FIRST-STAGE TURBINE WHEEL GAGE KIT 9021809



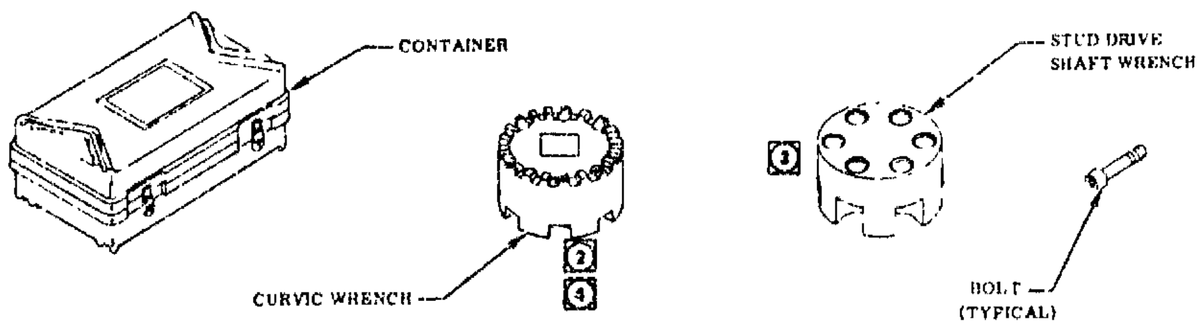

VIEW E
FUEL TURBINE STATIONARY-BLADE STACKING FIXTURE KIT 9022276



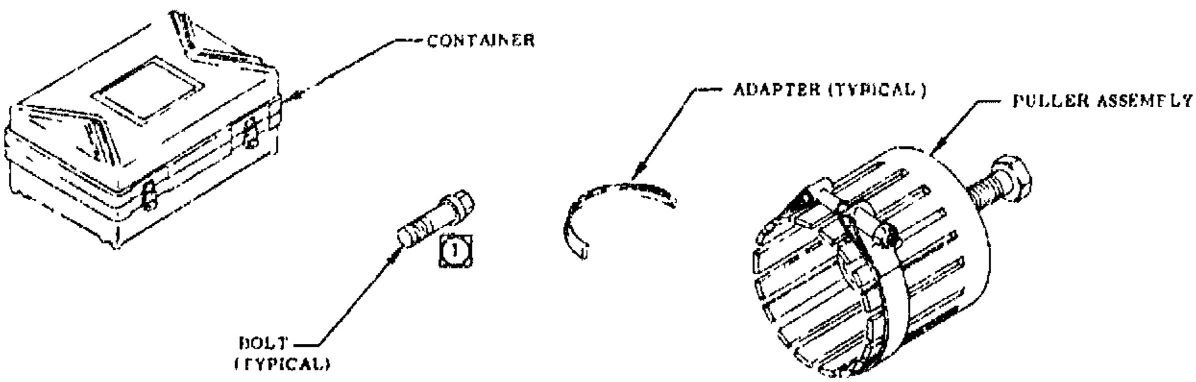

VIEW F
FUEL TURBINE DISK REMOVAL GUIDE PIN KIT 9022277

J2-5-2-16

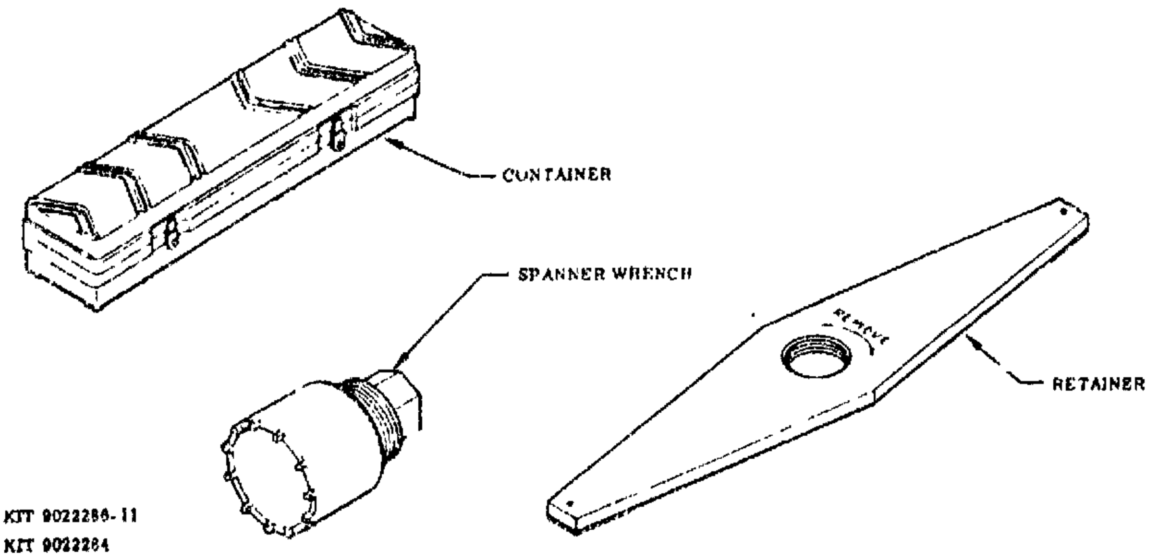
Figure 25-4. Fuel Turbopump Maintenance Set (Sheet 2 of 3)




VIEW G
FUEL TURBOPUMP SHAFT CURVIC WRENCH KITS 9022284, 9022284-11, AND 9022284-21




VIEW H
FUEL TURBOPUMP SPACER AND MATING RING SEAL PULLER KITS 9022286 AND 9022286-11




1 KIT 9022286-11
2 KIT 9022284
3 KIT 9022284-11
4 KIT 9022284-21

VIEW I
FUEL TURBOPUMP SEAL NUT SPANNER WRENCH KIT 9022287

J2-5-2-17

Figure 25-4. Fuel Turbopump Maintenance Set (Sheet 3 of 3)

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect turbopump maintenance kits for completeness. | X | X | | X | Prior to shipment. Replace missing parts. Refer to paragraphs 25-5 and 25-18. |
| Inspect tool surfaces that contact highly polished turbopump surfaces for nicks, scratches, and burs. | X | X | | | Replace tool. [a] Replace protective surfaces. Refer to paragraph 25-31. |
| Inspect threaded tools for binding, galling, or worn threads. | X | X | | | Replace or repair tool. [a] |
| Inspect moving surface of tools for damage that might impair operation of tool | X | X | | | Replace tool. |
| Calibrate fuel turbine stud torquing check tool 9021820. | | | | X | Every 6 months, or as necessary to verify parallel tolerance. Refer to paragraph 25-32. |
| Clean tools. | | X | X | | Refer to Cleaning in Volume I, section I. |

(a) The turbine wheel adapter tool is a matched set tool and must be replaced as a single unit.

Figure 25-5. Maintenance Requirements for Turbopump Maintenance Sets

## 25-31. REPAIRING TEFLON PROTECTIVE SURFACES.

**WARNING**

The following specifies adhesive EC776, which is flammable and must not be used near heat, sparks, or open flame. It is toxic. Inhalation of its vapors or prolonged contact with the adhesive can cause serious bodily harm. In case of prolonged exposure, immediately obtain fresh air and wash skin with soap and water.

Replace protective surfaces of retainers with Teflon sheet (etched on one side) RB0130-008 (Rocketdyne). Using adhesive EC776 (Minnesota Mining and Mfg), or equivalent, cement etched side of sheet to retainers.

## 25-32. CALIBRATING CHECK TOOL 9021820.

To provide stud stretch accuracy, the top surface of the check tool 9021820 must be parallel to the contacting turbine surface. Calibrate the check tool as follows:

a. Place check tool 9021820 on a known flat surface (with legs contacting surface), and using a dial indicator gage, verify that top surface of check tool is parallel to known flat surface within 0.0003 inch.

b. If check tool is not parallel (step a), loosen nuts RD114-1002-0004 and adjust legs 9021819, as necessary. (A one-degree turn of a leg is the equivalent of a 0.0001-inch change in the length of that leg.) Torque nuts to 8-10 inch-pounds. Repeat step a.

c. Make sure that accurate stripe marks connect nuts RD114-1002-0004 to legs 9021819 and to plate 9021818.

25-33. STORING TURBOPUMP MAINTENANCE KITS.

25-34. Store and ship maintenance tools in their respective reusable containers. Make sure tools are clean prior to placing in container.

# SECTION XXVI

# SEQUENCE CONTROLLER AND OXIDIZER HEAT EXCHANGER HANDLERS

WARNING

SEQUENCE CONTROLLER HANDLER 9016789 AND OXIDIZER HEAT EXCHANGER HANDLER 9016790 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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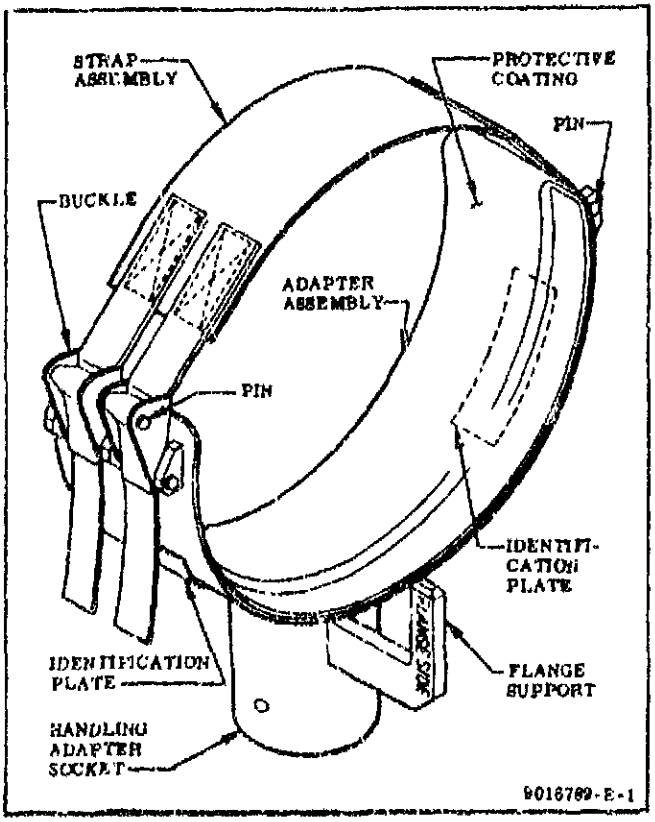


Figure 26-1. Sequence Controller Handler

## 26-1. DESCRIPTION AND LEADING PARTICULARS OF SEQUENCE CONTROLLER HANDLER 9016789.

26-2. The sequence controller handler (figure 26-1), with universal sling 9016779 and an overhead hoist, removes and installs the sequence controller. The handler consists of a C-shaped adapter frame with a protective coating on the inner surface, a handling adapter socket with a flange support lug, a strap, and two buckles. The C-shaped frame surrounds the controller and is secured with the strap and buckles. The flange support lug engages the controller and prevents lengthwise movement. Positioning the lug between the screw heads on the sequence controller flange prevents rotational movement. Instructions for use of the lug are stenciled on it. The handler has a work-load capacity of 45 pounds and is proof tested to 90 pounds. The handler straps are proof tested to 60 ±3 pounds. Instructions for the use of the handler are in R-3825-3.

## 26-3. DESCRIPTION AND LEADING PARTICULARS OF OXIDIZER HEAT EXCHANGER HANDLER 9016790.

26-4. The oxidizer heat exchanger handler (figure 26-2), with universal lifting sling 9016779 and an overhead hoist, removes and installs the heat exchanger, hot-gas test plate, and orifice plate. The handler consists of a lower and an upper adjustable C-shaped support frame with a strap and 2 buckles, a sliding tube support with a handling adapter socket, and 2 threaded rods with adjusting knobs. Handler 9016790-11 incorporates straps with relocated buckles, for attaching the handler, and inserts to prevent threaded rods from coming out during adjustment. The C-shaped support frames surround the bellows and are secured by the strap and buckle. Tightening the adjusting knobs compresses the bellows to allow installation or removal. Handler 9016790 has a work-load capacity of 75 pounds and is proof-tested to 150 pounds; handler 9016790-11 has a work-load capacity of 150 pounds and is proof tested to 300 pounds. The straps on handler 9016790-11 are proof tested to 100 ±5 pounds. Instructions for the use of the handler are in R-3825-3.

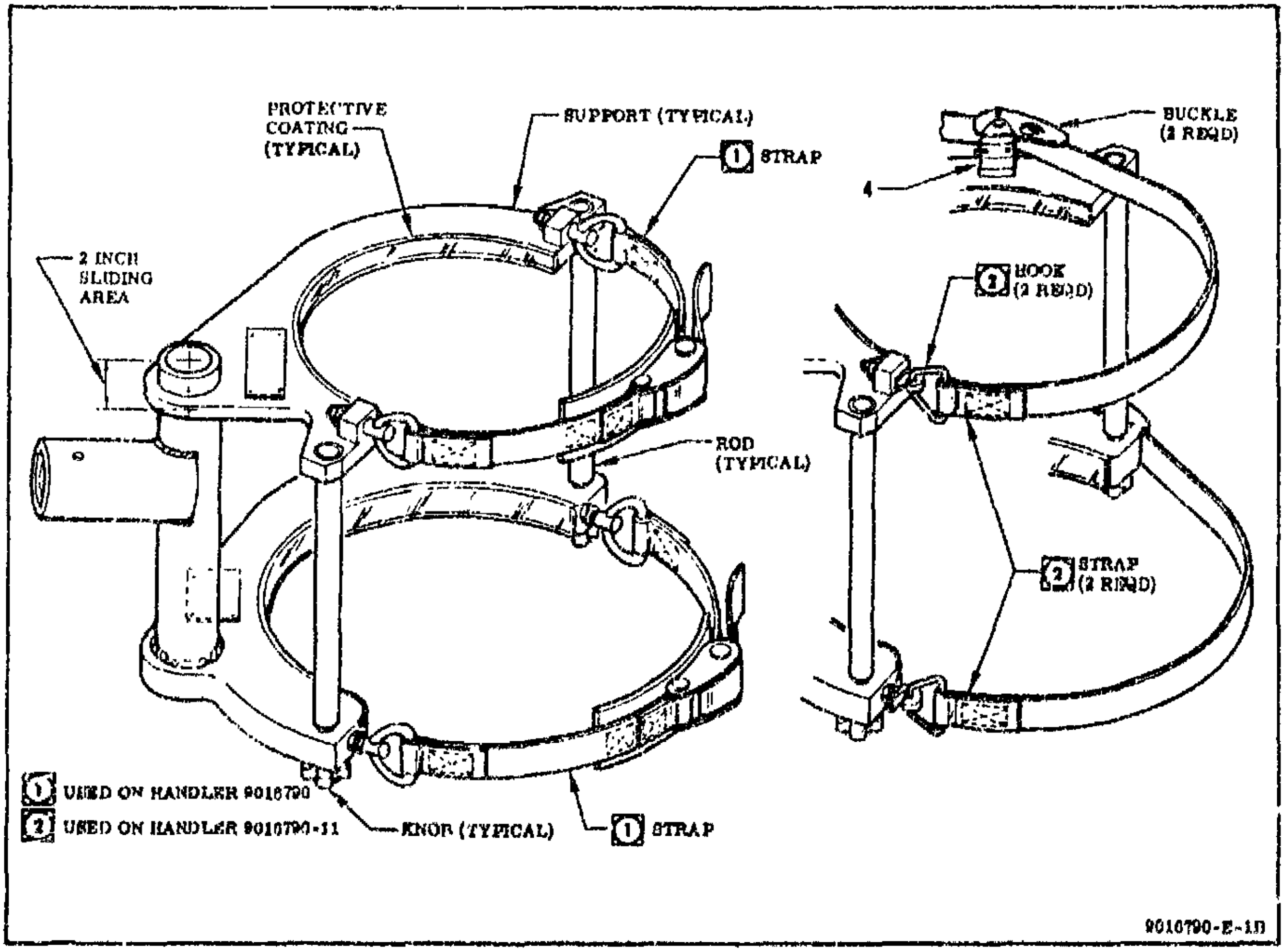


Figure 26-2. Oxidizer Heat Exchanger Handler

| Approved ECP Number | Part Number | Incorporated In Manual Dated |
|---|---|---|
| J2-237 | 9016790<br>-11 | 30 July 1964 |

Figure 26-3. Configuration Change - Manual Effectivity

26-5. CONFIGURATION CHANGE - MANUAL EFFECTIVITY.

26-6. The modification incorporated changing configuration of the oxidizer heat exchanger handler is listed in figure 26-3.

26-7. MAINTENANCE OF SEQUENCE CONTROLLER AND OXIDIZER HEAT EXCHANGER HANDLERS.

26-8. Maintenance tasks required on the handlers are listed in figure 26-4. Information presented lists the tasks to be performed, when they shall be performed, and where data support is found.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect handlers for: | | | | | |
| Completeness. | X | X | | X | Prior to shipment. See figures 26-1 and 26-2. |
| Broken, loose, or frayed straps or buckles. | X | X | | | Replace parts. |
| Damaged painted surfaces. | X | | | X | After each use, paint with orange-yellow enamel (MIL-E-7729, Type I), color 13538 (Federal Standard 595). |
| Inspect frame for cracked welds. | X | X | X | | Replace handler. |

Figure 26-4. Maintenance Requirements for Sequence Controller and Oxidizer Heat Exchanger Handlers (Sheet 1 of 2)

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect C-shaped frame for worn or damaged inner protective coating. | X | X | | | Repair coating. (Refer to R-3825-5, Volume I.) |
| Inspect sequence controller adapter socket for distorted broken, or bent flange support lug. | X | X | | | Replace handler. |
| Inspect sequence controller handler for obliterated identification plates. | X | | | X | After each use, paint with black lacquer (Federal Specification TT-L-32), color 17038 (Federal Standard 595). |
| Clean handlers. | | X | | | Refer to R-3825-5, Volume I. |
| Proof-test handlers. | | | | | |
| Sequence controller handler | | | | X | Every 6 months. Refer to paragraph 26-9. |
| Oxidizer heat exchanger handler | | | | X | Every 6 months if handler is used as a lifting or supporting device. (Refer to paragraph 26-9.) Proof-test not required if handler is used as a compression tool only. |

Figure 26-4. Maintenance Requirements for Sequence Controller and Oxidizer Heat Exchanger Handlers (Sheet 2 of 2)

## 26-9. PROOF-TESTING SEQUENCE CONTROLLER AND OXIDIZER HEAT EXCHANGER HANDLER STRAP ASSEMBLIES.

## 26-10. SEQUENCE CONTROLLER HANDLER STRAP ASSEMBLY.

a. Remove strap with buckles from sequence controller handler.

b. Support strap assembly in vertical position, using either pin, and extend strap assembly to maximum usable length.

WARNING

The test weight causes extreme strain on the strap assembly. Accelerating or jerking the proof-test weight during installation or while suspended, can cause undue strain and possible failure of the strap assembly, resulting in injury to personnel and damage to equipment.

c. Apply a 60 ±3 pound load to lower end of strap.

d. Remove proof load from strap assembly.

e. Reinstall strap assembly on sequence controller handler with pins, washers, and cotter pins.

26-11. OXIDIZER HEAT EXCHANGER HANDLER 9016790-11 STRAP ASSEMBLIES.

a. Remove screws securing buckle brackets to handler. (See figure 26-2.) Unhook other end of each strap assemblies and remove from handler.

b. Secure brackets so strap assemblies are in vertical position.

c. Extend strap assemblies to maximum usable length.

d. Apply a 100 ±5 pound load to lower end of each strap assembly.

WARNING

The test weight causes extreme strain on the strap assembly. Accelerating or jerking the proof-test weight during installation or while suspended, can cause undue strain and possible failure of the strap assembly, resulting in injury to personnel and damage to equipment.

e. Remove proof load from each strap assembly.

f. Reinstall strap assemblies on handler. Refer to Torque Values for Bolts, Nuts, and Screws in R-3825-5, Volume I.

# SECTION XXVII

# PROPELLANT INLET DUCT HANDLERS

WARNING

FUEL INLET DUCT HANDLER 9016784 AND OXIDIZER INLET DUCT HANDLER 9016785 MUST BE OPERATED BY AUTHORIZED PERSONNEL.

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## 27-1. DESCRIPTION AND LEADING PARTICULARS OF FUEL INLET DUCT HANDLER 9016784.

27-2. The fuel inlet duct handler (figure 27-1) is used with universal lifting sling 9016779 and an overhead hoist to remove and install the fuel inlet duct when the engine is in the horizontal position. The handler consists of 2 plates, each incorporating an adjustable wedge support which attach to the engine duct stabilizer lugs and secure the handler to the duct. One plate, consisting of a tubular frame, incorporates an adapter socket, to attach to the universal sling, and an adjustable, 2-position slide arm. The other plate incorporates 3 compression screws, a chain-drive mechanism, and a ratchet wrench. The chain-drive mechanism compresses the duct bellows to clear the turbopump impeller protruding into the duct. An instruction plate for the ratchet wrench is on the handler. The handler has a workload capacity of 140 pounds and is proof tested to 280 pounds. Instructions for the use of the handler are in R-3825-1B and R-3825-3.

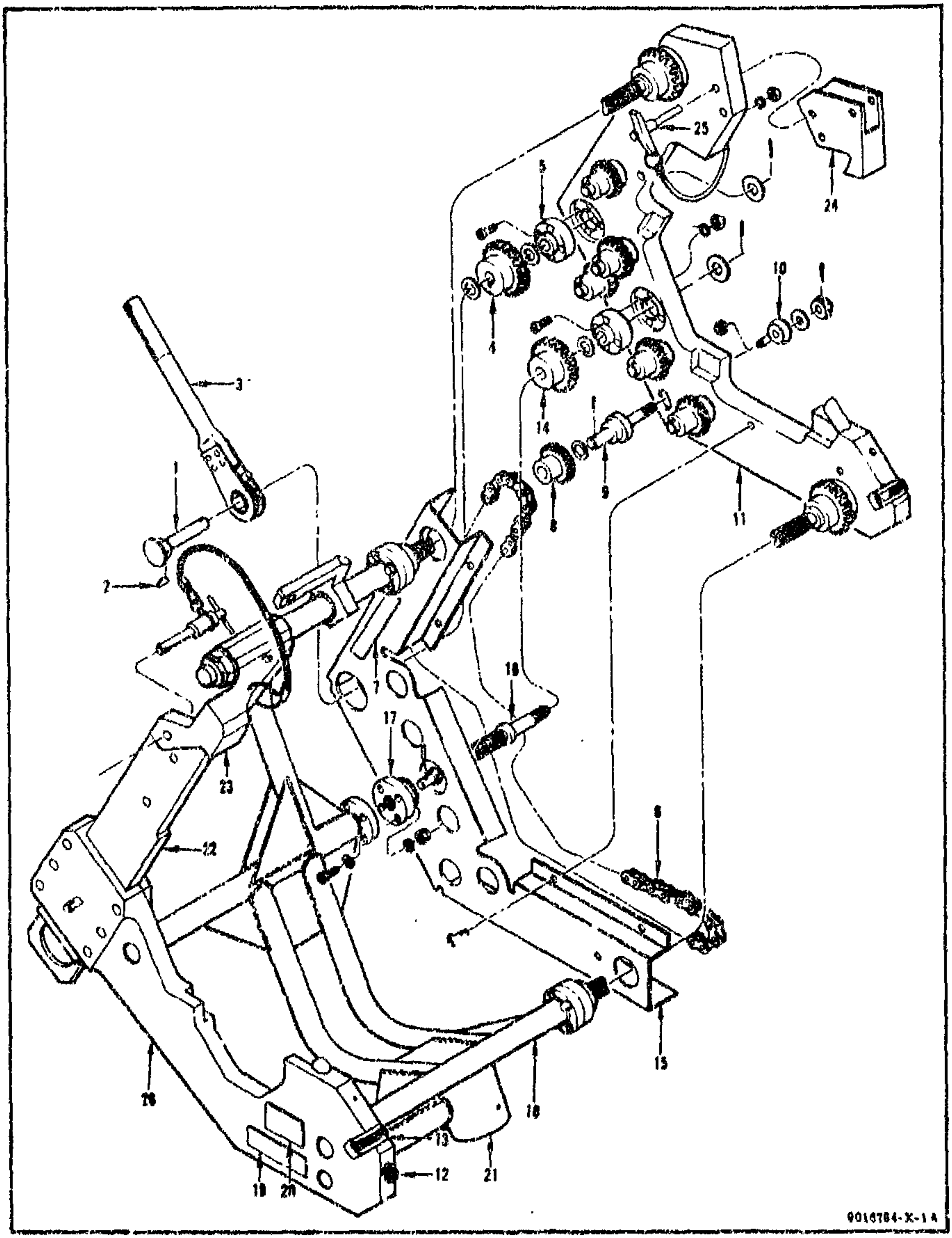


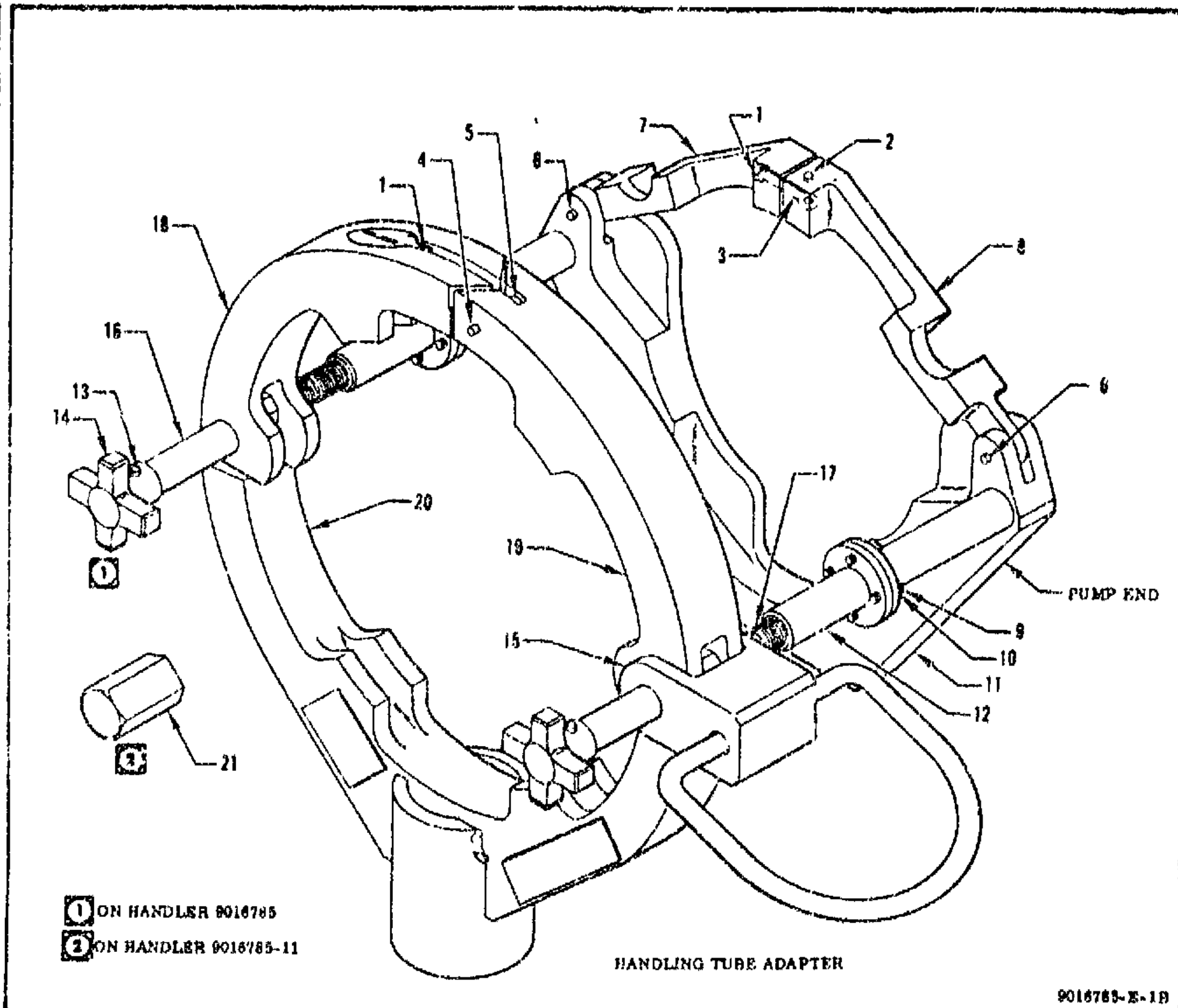

Figure 27-1. Fuel Inlet Duct Handler (Sheet 1 of 2)

| Index Number | Nomenclature | Index Number | Nomenclature |
|---|---|---|---|
| 1 | Pin | 14 | Sprocket (3 reqd) |
| 2 | Key | 15 | Guard |
| 3 | Wrench | 16 | Compression Screw (3 reqd) |
| 4 | Sprocket | 17 | Block (3 reqd) |
| 5 | Bushing | 18 | Frame |
| 6 | Chain | 19 | Identification Plate |
| 7 | Instruction Plate | 20 | Identification Plate |
| 8 | Sprocket (6 reqd) | 21 | Handler Adapter Socket |
| 9 | Pin (6 reqd) | 22 | Slide Arm |
| 10 | Adjusting Link | 23 | Slide Lock |
| 11 | Plate | 24 | Stop |
| 12 | Wedge Support (2 reqd) | 25 | Pin |
| 13 | Adjusting Nut (2 reqd) | 26 | Plate Assembly |

Figure 27-1. Fuel Inlet Duct Handler (Sheet 2 of 2)

27-3. DESCRIPTION AND LEADING PARTICULARS OF OXIDIZER INLET DUCT HANDLER 9016785.

27-4. The oxidizer inlet duct handler (figure 27-2) is used with universal sling 9016779 and an overhead hoist to remove and install the oxidizer inlet duct when the engine is in the horizontal position. The handler consists of 2 end frame plates and a clevis. One plate incorporates a handling tube adapter, 2 hinged arms, an eyebolt lock, 2 flanged nuts, and 2 threaded rods with knobs. The other plate incorporates 2 hinged arms, an eyebolt lock, and 2 tubular beams on the outer ends. The 2 frames are joined by screws installed through the tubular flanged beams into the flanged nuts. Handler 9016785-11 incorporates threaded rods of increased length, flanged nuts of decreased length, and a hexagonal adapter to provide wrenching surfaces to adjust handler. The handler is placed around the duct and secured with the hinged arms and eyebolts. One end plate clamps on the duct flange mounted on the turbopump. The other plate is mounted on the inlet flange. The inlet duct is compressed by adjusting the threaded rods. The clevis aids in hoisting the handler. The handler has a work-load capacity of 120 pounds and is proof-tested to 240 pounds. Instructions for the use of the handler are in R-3825-1B and R-3825-3.




| Index Number | Nomenclature | Index Number | Nomenclature |
|---|---|---|---|
| 1 | Nut | 11 | Frame |
| 2 | Pin | 12 | Flanged Nut |
| 3 | Eyebolt | 13 | Pin |
| 4 | Pin | 14 | Knob |
| 5 | Eyebolt | 15 | Clevis Assembly |
| 6 | Pin | 16 | Spacer |
| 7 | Arm | 17 | Threaded Rod |
| 8 | Arm | 18 | Arm |
| 9 | Screw | 19 | Arm |
| 10 | Washer | 20 | Frame |
| | | 21 | Adapter |

Figure 27-2. Oxidizer Inlet Duct Handler

27-5. CONFIGURATION CHANGE--MANUAL EFFECTIVITY.

27-6. The modification incorporated changing the configuration of the oxidizer inlet duct handler is listed in figure 27-3.

| Approved ECP No. | Part No. | Incorporated in Manual Dated |
|---|---|---|
| | 9016785 | |
| J2-543 | -11 | 19 January 1967 |

Figure 27-3. Configuration Change--Manual Effectivity

27-7. MAINTENANCE OF PROPELLANT INLET DUCT HANDLERS.

27-8. Maintenance tasks required on the handlers are listed in figure 27-4. Information presented lists the tasks to be performed, when they must be performed, and reference to data to accomplish these tasks.

27-9. PROOF-TESTING PROPELLANT INLET DUCT HANDLERS.

a. Prepare a test fixture to fit handler adapter socket. Engine Component Installer G4071 or G4072 may be used as the test fixture.

b. Install handler on test fixture (or on installer) as shown in figure 27-5. Make sure that pump end of handler is down.

c. Apply proof-weight load at center-of-gravity point indicated in figure 27-5. (A board or metal plate may be used to support weight across pump end of handler.) Proof-weight load for fuel inlet duct handler is 280 pounds. Proof-weight load for oxidizer inlet duct handler is 240 pounds. Proof weights PW69-784 and PW69-785 may be used to test fuel inlet duct handler and oxidizer inlet duct handler if these weights meet the proof-load requirements.

d. After a minimum of 3 minutes, remove proof-weight load. Remove handler from test fixture and inspect handler for cracks.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect handlers for: | | | | | |
| Completeness. | X | | | X | Prior to shipment. See figures 27-1 and 27-2. |
| Damaged painted surfaces. | X | | X | | Paint with orange-yellow enamel (Federal Specification TT-E-489); color 13538 (Federal Standard 595). |
| Obliterated identification plates. | X | | X | | Paint with black lacquer (Federal Specification TT-L-32); color 17038 (Federal Standard 595). |
| Loose or missing nuts, screws, pins, and eye-bolts. | X | | X | | Replace or tighten hardware. Refer to Torque Values for Nuts, Bolts, and Screws in R-3825-5, Volume I. |
| Inspect threaded rods for worn, damaged, or binding threads. | X | X | | | Replace rods. |
| Inspect frame for cracked welds. | X | X | | | Replace handler. |
| Inspect fuel inlet duct handler for: | | | | | |
| Chain-drive mechanism and threaded rods for foreign matter. | X | X | | | Refer to R-3825-5, Volume I for cleaning procedures. |
| Worn or damaged sprockets, bushings, or pins. | X | X | | | Replace parts. |
| Broken or inoperative ratchet wrench. | X | X | | | Replace wrench. |

Figure 27-4. Maintenance Requirements for Propellant Inlet Duct Handlers (Sheet 1 of 2)

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Bent wedge support and binding adjustment nut. | X | X | | | Engage tip of setscrew in slot to allow free linear motion and to prevent rotation of wedge support; otherwise, replace parts. |
| Tension sprocket adjustment. | | | | X | Whenever chain is installed. Adjust shaft by tightening castellated nut fingertight and installing cotter pin. |
| Chain adjustment. | | | | X | Whenever chain is installed. Manually move tension sprocket toward chain adjustment nut to remove slack from chain. Tighten chain adjustment nut until it seats on end plate. Back off nut 1/2 turn. Sprocket shall move slightly with hand pressure. |
| Inspect oxidizer inlet duct handler for: | | | | | |
| Missing or damaged knobs or adapters. | X | X | | | Remove pin, replace knobs or adapters, and replace pin. |
| Bent arms, pins, or eyebolts. | X | X | | | Replace parts. |
| Proof-test handlers. | | | | X | Every 12 months. Required only on handlers to be used within a stacked Saturn vehicle. (Refer to paragraph 27-9.) |

Figure 27-4. Maintenance Requirements for Propellant Inlet Duct Handers (Sheet 2 of 2)

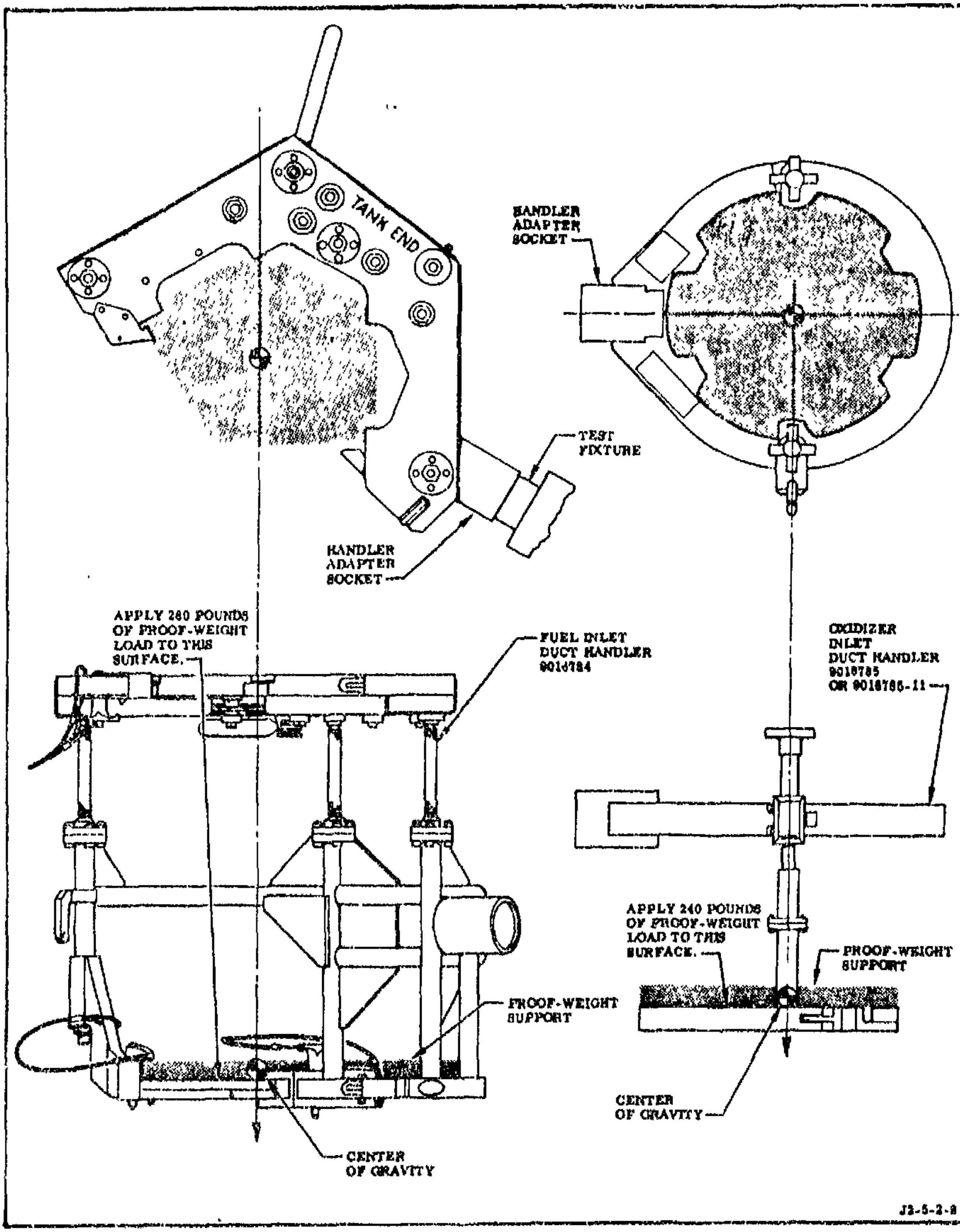



Figure 27-5. Proof-Testing Propellant Inlet Duct Handlers

# SECTION XXVIII

# PROPELLANT FEED SYSTEM HANDLERS

WARNING

OXIDIZER FEED SYSTEM HANDLER 9016786 AND FUEL FEED SYSTEM HANDLER 9016787 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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## 28-1. DESCRIPTION AND LEADING PARTICULARS OF OXIDIZER FEED SYSTEM HANDLER 9016786.

28-2. The oxidizer feed system handler (figure 28-1), with universal sling 9016779, removes and installs the oxidizer feed system duct. The handler consists of a tubular beam, with an adapter socket to attach to the sling, and two nylon-webbing straps, with snap hooks to handle the duct. Two sets of hooks are welded to the beam ends. The black hooks handle the duct when the engine is in a vertical position; the red hooks, in a horizontal position. The handler has a work-load capacity of 65 pounds and is proof-tested to 130 pounds. Instructions for the use of the handler are in R-3825-3.

## 28-3. DESCRIPTION AND LEADING PARTICULARS OF FUEL FEED SYSTEM HANDLER 9016787.

28-4. The fuel feed system handler (figure 28-2), with universal sling 9016779, removes and installs the fuel feed system duct when the engine is in a horizontal position. The handler consists of a tubular frame with an adapter socket to attach to the sling. A support plate is attached to one end of the beam to prevent end movement of the duct. Four spring-loaded hooks, two of them hinged, attach to the duct tie rods to secure the duct to the handler. The handler strap supports the duct fuel bootstrap line. The handler has a work-load capacity of 80 pounds and is proof-tested to 160 pounds. Instructions for the use of the handler are in R-3825-3.

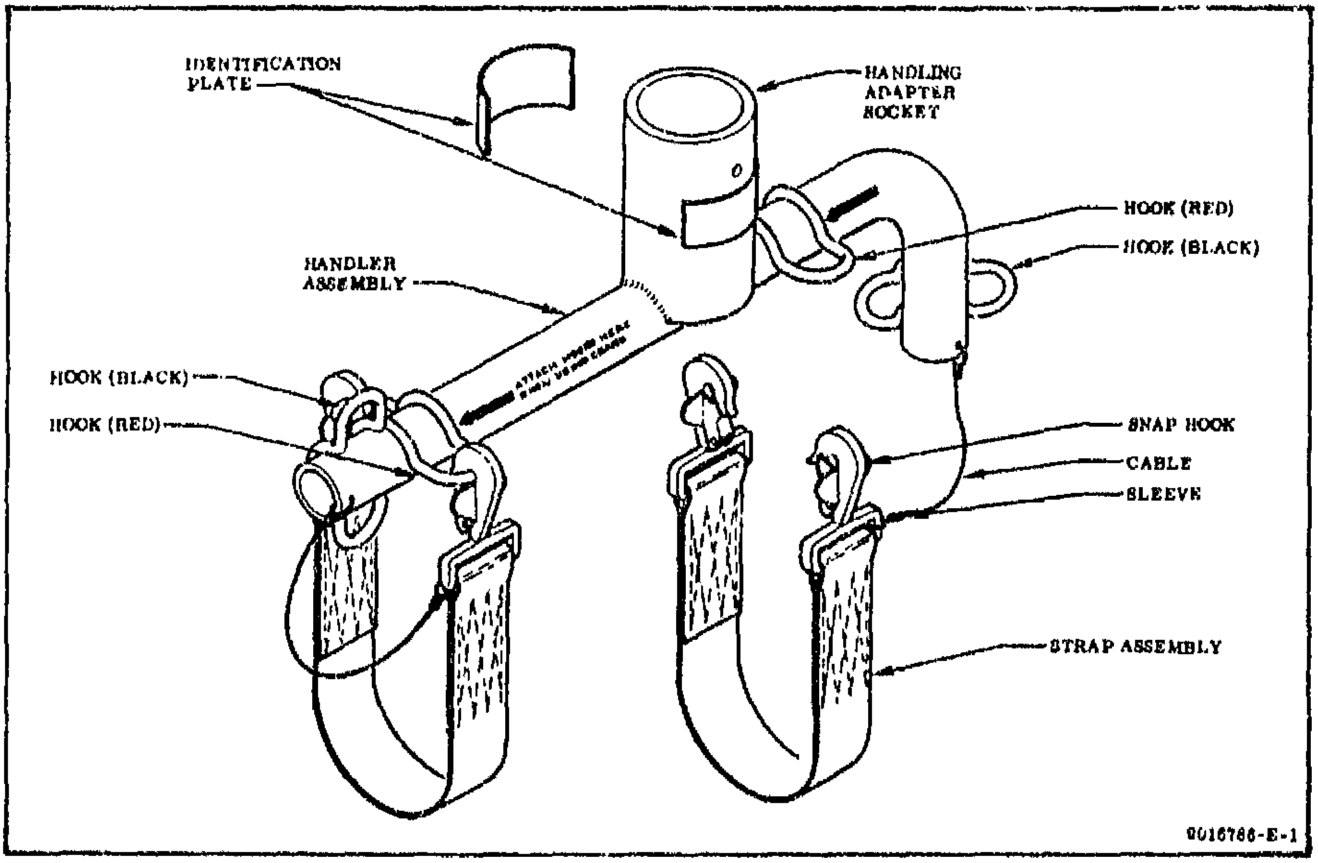


Figure 28-1. Oxidizer Feed System Handler

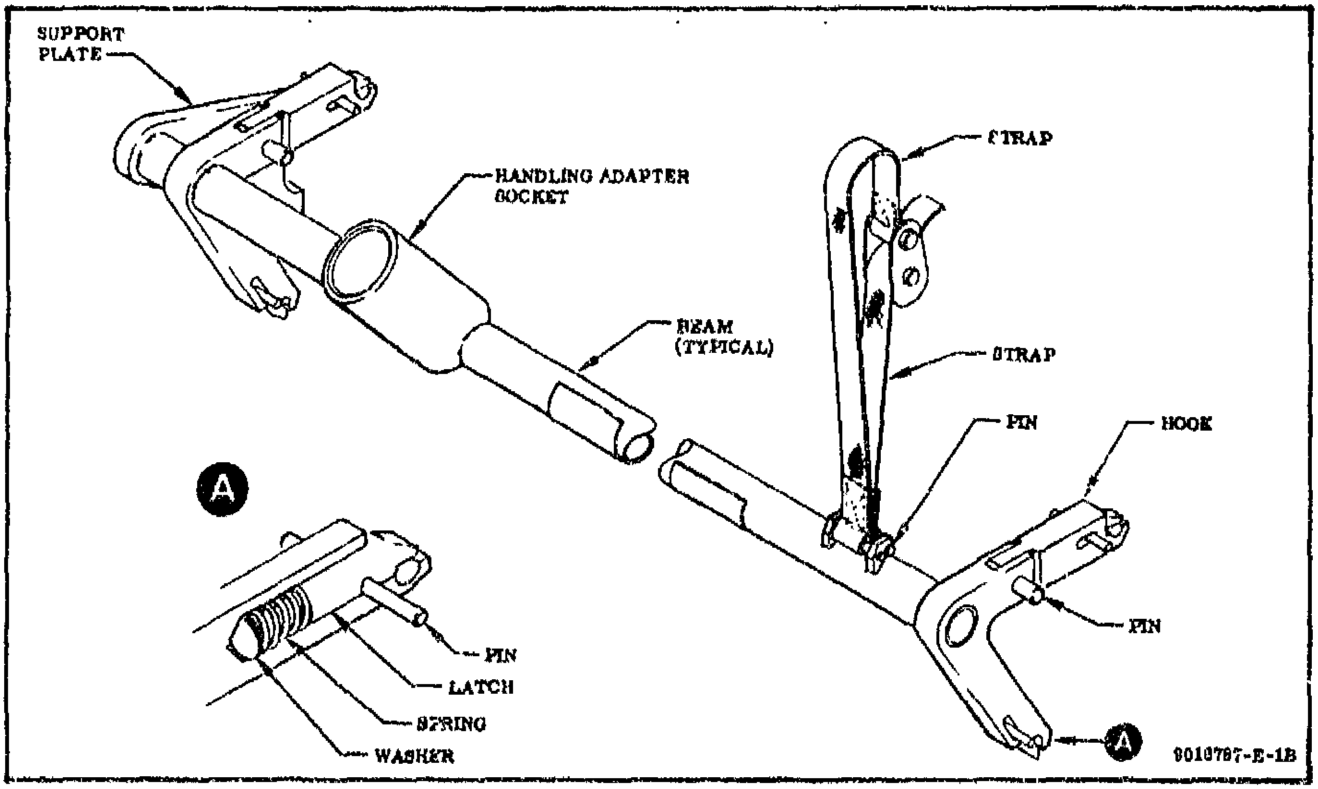


Figure 28-2. Fuel Feed System Handler

| Approved ECP Number | Part Number | Incorporated In Manual Dated |
|---|---|---|
| J2-239 | 9016787<br>-11 | 30 July 1964 |

Figure 28-3. Configuration Change - Manual Effectivity

28-5. CONFIGURATION CHANGE - MANUAL EFFECTIVITY.

28-6. The modification incorporated changing configuration of the fuel feed system handler is listed in figure 28-3.

28-7. MAINTENANCE OF PROPELLANT FEED SYSTEM HANDLERS.

28-8. Maintenance tasks required on the propellant feed system handlers are listed in figure 28-4. Information presented lists the tasks to be performed, when they shall be performed, and where data support is found.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect handlers for: | | | | | |
| Completeness. | X | X | | X | Prior to shipment. See figures 28-1 and 28-2. |
| Frayed, broken, or deteriorated straps. | X | X | | | Replace straps. |
| Damaged painted surfaces. | X | | X | X | After each use, paint with orange-yellow enamel (MIL-E-7729, Type I), color 13538 (Federal Standard 595). For outboard clips use black enamel (MIL-E-7729, Type I), color 17038 (Federal Standard 595). For inboard clips use red enamel (MIL-E-7729, Type I); color 11136 (Federal Standard 595). |

Figure 28-4. Maintenance Requirements for Propellant Feed System Handlers (Sheet 1 of 2)

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Damaged or worn hooks or buckles. | X | X | | | Replace parts. |
| Inspect beam for cracked welds. | X | X | | | Replace handler. |
| Inspect oxidizer feed system handler for: | | | | | |
| Frayed, loose, or broken cables. | X | X | | | Replace cables. |
| Obliterated identification plates. | X | | X | | Paint with black lacquer (Federal Specification TT-L-32), color 17038 (Federal Standard 595). |
| Inspect fuel feed system handler for: | | | | | |
| Binding or inoperative hook latches. | X | X | | | Replace latches. |
| Broken springs. | X | X | | | Replace springs. |
| Proof-test oxidizer feed system handler | | | | X | Every 6 months. Refer to paragraph 28-9. |

Figure 28-4. Maintenance Requirements for Propellant Feed System Handlers (Sheet 2 of 2)

## 28-9. PROOF-TESTING OXIDIZER FEED SYSTEM HANDLER STRAP ASSEMBLIES.

28-10. Proof-testing the oxidizer feed system handler consists of removing the strap assemblies and applying a specified load to each strap assembly.

a. Unhook strap assemblies from handler assembly.

b. Support each strap assembly by one hook, in vertical position. Support handler assembly independently of strap assemblies to avoid pre-loading strap assemblies or hooks.

WARNING

Do not allow handler assembly to be supported by strap assembly security cables, since cables can break under the load, causing injury to personnel or damage to equipment.

c. Apply a 100 ±5 pound load to lower hook of each strap.

WARNING

Test weight causes extreme strain on strap assembly. Accelerating or jerking the proof-test weight during installation or while suspended can cause undue strain and possible failure of the strap assembly, resulting in injury to personnel or damage to equipment.

d. Remove proof-load from strap assemblies.

e. Hook strap assemblies to handler assembly.

# SECTION XXIX

# START TANK INSTALLER 9016783

WARNING

START TANK INSTALLER 9016783 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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## 29-1. DESCRIPTION AND LEADING PARTICULARS OF START TANK INSTALLER.

29-2. The start tank installer (figure 29-1), with the start tank sling, removes and installs the start tank when the engine is installed on Engine Handler G4034 or G4064. The installer consists of a platform with 2 channel tracks, supported by 2 folding legs, and a dolly with a padded ring, supported by 3 adjustable caster wheels which attach to the ring by lockpins. Turning the knurled adjustment knob above each caster raises or lowers the padded ring up to 3 inches. The platform is assembled and secured with lockpins. The legs and channel tracks may be folded onto the platform when the installer is not in use. The channel tracks of installer 9016783-11 are reinforced to increase the work-load capacity, the padded ring is chamfered to create a larger bearing surface to support the start tank, and protective rubber caps are added to the top of the adjustable caster wheels to protect engine components from damage. Installer 9016783 has a work-load capacity of 80 pounds and is proof-tested to 160 pounds; installer 9016783-11 has a work-load capacity of 100 pounds and is proof-tested to 200 pounds. Instructions for the use of the installer are in Technical Manual R-3825-3.

## 29-3. CONFIGURATION CHANGE - MANUAL EFFECTIVITY.

29-4. The modification incorporated changing configuration of the start tank installer is listed in figure 29-2.

## 29-5. MAINTENANCE OF START TANK INSTALLER.

29-6. Maintenance tasks required on the installer are listed in figure 29-3. Information presented lists the tasks to be performed, when they shall be performed, and where data support is found.

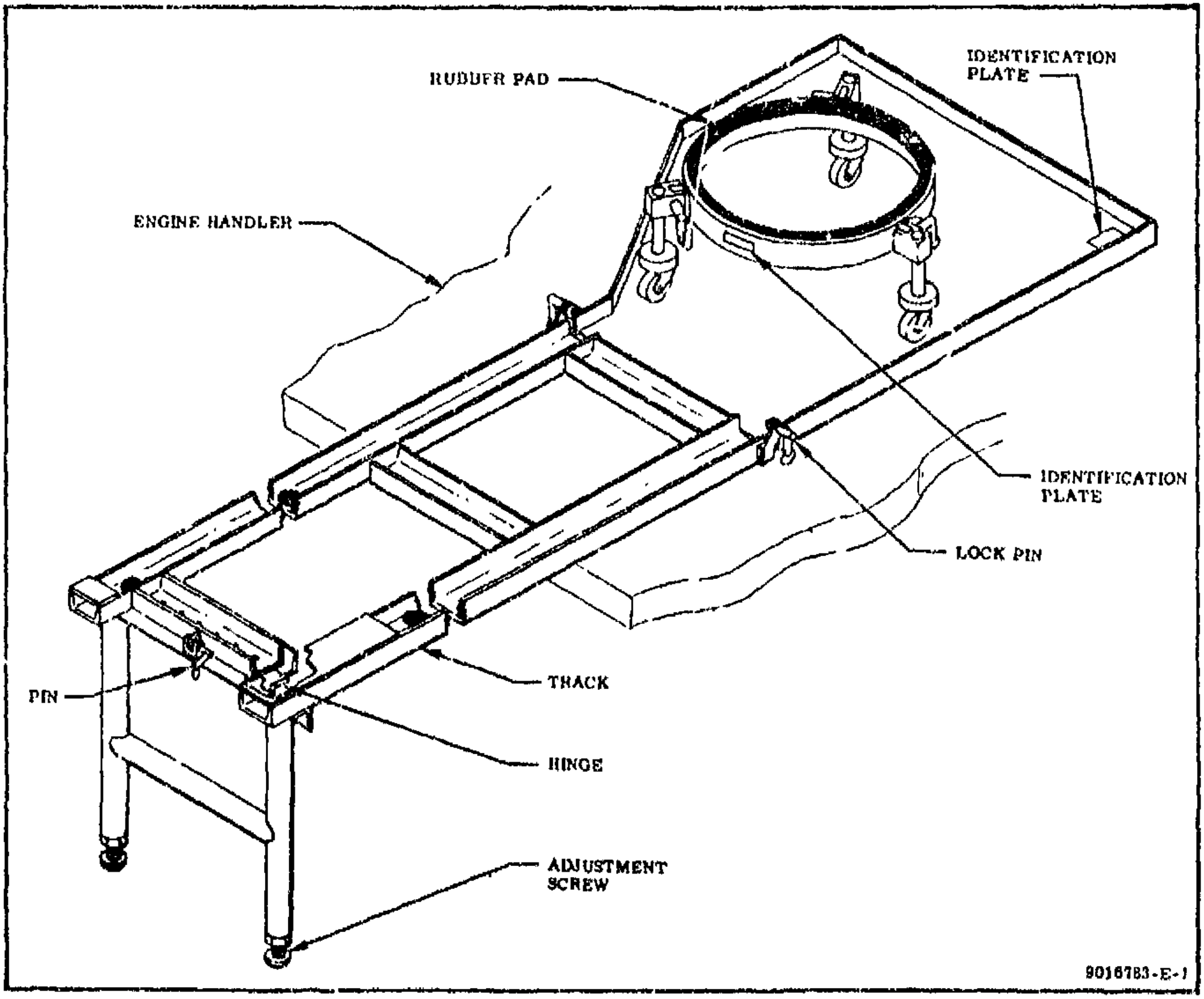


Figure 29-1. Start Tank Installer

| Approved ECP Number | Part Number | Incorporated In Manual Dated |
|---|---|---|
| J2-206 | 9016783<br>-11 | 29 March 1965 |

Figure 29-2. Configuration Change - Manual Effectivity

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect installer for: | | | | | |
| Completeness | X | X | | X | Prior to shipment. See figure 29-1. |
| Bent or missing lockpins. | X | X | | | Replace lockpins. |
| Bent frame or cracked welds. | X | X | | | Replace frame. |
| Binding or inoperative leg adjustment screws. | X | X | | | Replace screws. |
| Worn, damaged, or binding caster threads. | X | X | | | Replace casters. |
| Damaged painted surfaces. | X | | X | X | After each use, paint with orange-yellow enamel (Federal Specification TT-E-489), color 13538 (Federal Standard 595). |
| Obliterated identification plates. | X | | | X | After each use, paint with black lacquer (Federal Specification TT-L-32), color 17038 (Federal Standard 595). |
| Clean installer. | | | | X | Refer to R-3825-5, Volume I for cleaning procedures. |
| Inspect dolly rubber pad for damage or deterioration. | X | X | | | Replace pad. |

Figure 29-3. Maintenance Requirements for Start Tank Installer

# SECTION XXX

# FLUID LINES INTERFACE SUPPORT 9020628 AND FLUID LINES INTERFACE ARM SUPPORT 9026988

WARNING

FLUID LINES INTERFACE SUPPORT 9020628 AND FLUID LINES INTERFACE ARM SUPPORT 9026988 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.

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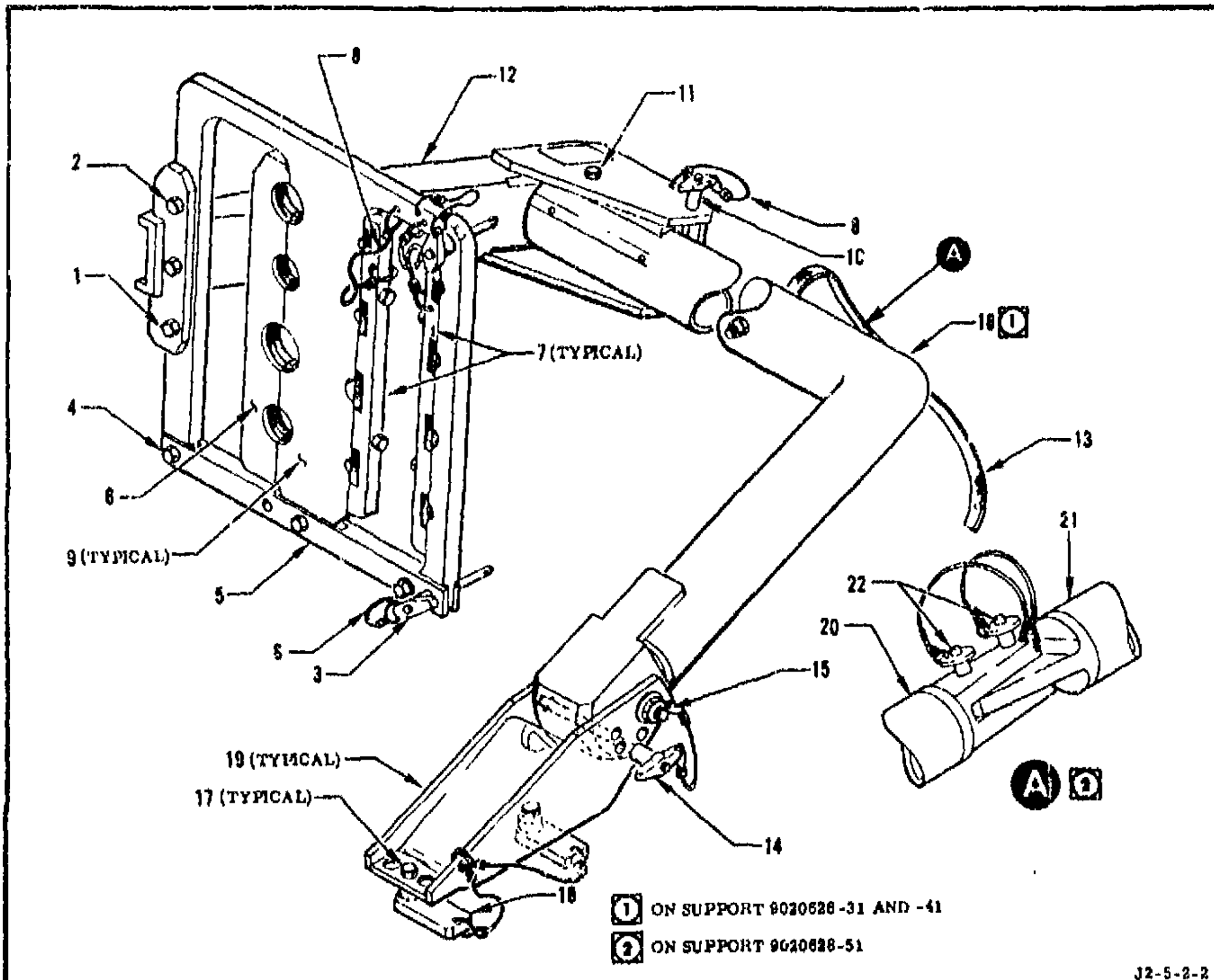
## 30-1. DESCRIPTION AND LEADING PARTICULARS OF FLUID LINES INTERFACE SUPPORT 9020628.

30-2. The fluid lines interface support (figure 30-1), supports the engine connect fluid and pneumatic lines position when the engine is installed on the engine handler or vertical installer, or when the engine is being handled, or being installed in the vehicle. The interface support is secured by engine handler equipment for transport on the handler, and is adjustable to permit manipulation of the flexible lines during engine rotation or installation. The support consists of a tubular beam arm with an adjustable handler support bracket, two rectangular nuts, a strap and buckle, and an adapter with a tube clamp support incorporating padded tube clamps to accommodate various tube sizes. Support 9020628-41 increases the depth of the 3/8-inch diameter clamping notch to accommodate 1/2-inch diameter tubing. Support 9020628-51 incorporates an elbow joint in the tubular arm to permit positioning of the interface panel and adjustment for clearance during engine installation. Instructions for the use of the support are in R-3825-1B and R-3825-3.

## 30-3. CONFIGURATION CHANGES--MANUAL EFFECTIVITY.

30-4. Modifications incorporated changing configuration of the fluid lines interface support are listed in figure 30-2.




| Index Number | Nomenclature | Index Number | Nomenclature |
|---|---|---|---|
| 1 | Bolt | 6 | Clamp Assembly |
| | Washer | | Captive Bolt (2 reqd) (Alternate AN107431) |
| | Nut | | Washer (2 reqd) |
| 2 | Bolt (2 reqd) | 7 | Clamp Assembly |
| | Washer (2 reqd) | | Captive Bolt (4 reqd) |
| | Nut (2 reqd) | | Washer (4 reqd) |
| 3 | Pin (2 reqd) | 8 | Cable (5 reqd) |
| 4 | Bolt (3 reqd) | | Sleeve (10 reqd) |
| | Washer (3 reqd) | 9 | Clamp Assembly |
| | Nut (3 reqd) | | |
| 5 | Gate | | |

Figure 30-1. Fluid Lines Interface Support (Sheet 1 of 2)

| Index Number | Nomenclature |
|---|---|
| 10 | Pin |
| | Cable |
| | Sleeve (2 reqd) |
| 11 | Bolt |
| | Nut |
| | Washer (2 reqd) |
| 12 | Channel Arm |
| 13 | Strap Assembly |
| 14 | Pin |
| | Cable |
| | Sleeve (2 reqd) |
| 15 | Clevis Bolt |
| | Nut |
| | Washer |
| 16 | Arm |
| 17 | Captive Bolt |
| | Washer (2 reqd) |
| 18 | Nut (2 reqd) |
| 19 | Handler Support Bracket |
| | Cable (2 reqd) |
| | Sleeve (4 reqd) |
| 20 | Elbow |
| | Clevis |
| | Bolt[a] (2 reqd) |
| | Nut[a] (2 reqd) |
| | Washer[a] (2 reqd) |
| 21 | Arm |
| | Lug |
| | Bolt[a] (2 reqd) |
| | Nut[a] (2 reqd) |
| | Washer[a] (2 reqd) |
| 22 | Pin (2 reqd) |
| | Cable (2 reqd) |
| | Sleeve (4 reqd) |

(a) Not used if clevis and lug are welded.

Figure 30-1. Fluid Lines Interface Support (Sheet 2 of 2)

## 30-5. MAINTENANCE OF FLUID LINES INTERFACE SUPPORT.

30-6. Maintenance tasks required on the interface support are listed in figure 30-3. Information presented lists the tasks to be performed, when they shall be performed, and where data support is found.

| Approved ECP Number | Part Number | Incorporated In Manual Dated |
|---|---|---|
| | 9020628 | |
| J2-135 | -11 | 30 July 1964 |
| J2-193 | -21 | 30 July 1964 |
| J2-205 | -31 | 30 July 1964 |
| J2-473 | -41 | 7 January 1966 |
| J2-480 | -51 | 3 May 1966 |

Figure 30-2. Configuration Changes - Manual Effectivity

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect interface support for: | | | | | |
| Completeness. | X | X | | X | Prior to shipment. See figure 30-1. |
| Frayed, loose, or broken cables. | X | X | | | Replace cables. |
| Bent or missing pins. | X | X | | | Replace pins. |
| Missing or damaged inserts. | X | X | | | Replace inserts. |
| Cracked welds. | X | X | | | Replace arm. |
| Damaged painted surfaces. | X | | | X | After each use and prior to storage, paint exposed surfaces with red enamel (Federal Specification TT-E-489), color 11136 (Federal Standard 595). |
| Clean interface support. | | X | | | Refer to R-3825-5, Volume I for cleaning procedures. |

Figure 30-3. Maintenance Requirements for Fluid Lines Interface Support

30-7. DESCRIPTION AND LEADING PARTICULARS FOR FLUID LINES INTERFACE ARM SUPPORT 9026988.

30-8. The fluid lines interface arm support (figure 30-3) is used to replace the fluid lines interface arm to support customer connect fluid lines during engine installation into the SIVB stage, series 500 vehicle. The arm supports fluid lines with the engine in a horizontal or vertical position and during rotation of the engine. The arm support must be replaced with the fluid lines interface arm for engine shipment. Instructions for use of the arm support are in R-3825-3.

30-9. MAINTENANCE OF FLUID LINES INTERFACE ARM SUPPORT.

30-10. Maintenance tasks on the arm support are listed in figure 30-5. Information presented lists the tasks to be performed, when they must be performed, and reference to data to accomplish these tasks.

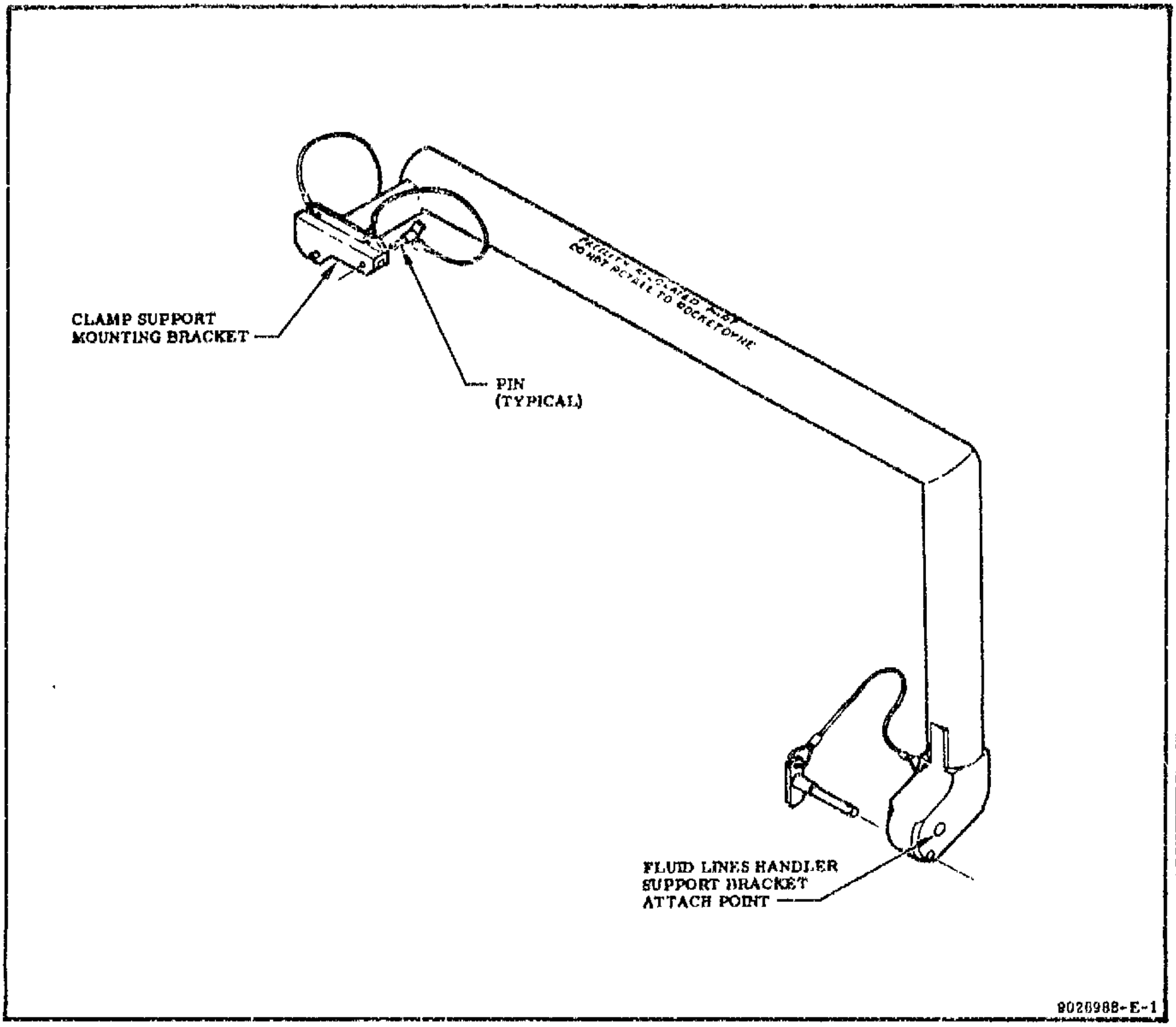



Figure 30-4. Fluid Lines Interface Arm Support

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect arm support for: | | | | | |
| Completeness. | X | X | | | See figure 30-3. |
| Frayed, loose, or broken cables. | X | X | | | Replace cables. |
| Bent or missing pins. | X | X | | | Replace pins. |
| Cracked welds. | X | X | | | Replace arm. |
| Damaged painted surfaces. | X | | | X | After each use and prior to storage, paint exposed surfaces with red enamel (Federal Specification TT-E-489), color 11136 (Federal Standard 595). |
| Obliterated markings. | X | | | X | After each use and prior to storage. Stencil markings with lacquer (Federal Specification TT-L-32); color 37875 (Federal Standard 595). |
| Clean interface arm support. | | X | | | Refer to R-3825-5, Volume I for cleaning procedures. |

Figure 30-5. Maintenance Requirements for Fluid Lines Interface Arm Support

# SECTION XXXI

# THRUST CHAMBER SEAL BALLOON 9016720

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## 31-1. DESCRIPTION AND LEADING PARTICULARS OF THRUST CHAMBER SEAL BALLOON.

31-2. The thrust chamber seal balloon is a flaccid, spherical balloon 50 inches in diameter. A 1/4-inch diameter inlet tube is 30 feet long and contains a valve at the inlet. The balloon is placed in the thrust chamber and inflated with helium or nitrogen gas. It occupies space and prevents contamination and moisture from entering the combustion chamber, injector, and hot-gas ports. Instructions for the use of the balloon are in Technical Manual R-3825-3.

## 31-3. MAINTENANCE OF THRUST CHAMBER SEAL BALLOON.

31-4. Maintenance tasks required on the balloon are listed in figure 31-1. Information presented lists the tasks to be performed, when they shall be performed, and where data support is found.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect balloon for cuts, abrasions, foreign matter, and contamination. | | X | | | Replace balloon. |
| Package balloon. | | | X | | Coat entire exterior surface with talc (MIL-T-50036). Wrap in film (MIL-F-22191) and package in a bag fabricated from film. Exhaust excess air from bag and heat seal. Individually pack balloon in a folding box (Federal Specification PPP-B-566), and identify. |

Figure 31-1. Maintenance Requirements for Thrust Chamber Seal Balloon

# SECTION XXXII

# SPARK IGNITER CABLE PRESSURIZATION TOOL KIT 9025425

## WARNING

**SPARK IGNITER CABLE PRESSURIZATION TOOL KIT 9025425 MUST BE OPERATED BY AUTHORIZED PERSONNEL TRAINED IN THE USE OF THE EQUIPMENT.**

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Underlined titles denote primary paragraphs.

## 32-1. DESCRIPTION AND LEADING PARTICULARS.

32-2. The pressurization tool kits (figure 32-1) are used to pressurize, leak test, monitor pressure, and repressurize the electrical control assembly, the flight instrumentation packages, and the installed spark igniter cables. Kit 9025425-11 consists of a spark igniter cable pressurization manifold assembly, a spark igniter cable pressure monitor adapter assembly, a package and cable pressurizing adapter assembly, an electrical package pressure monitor adapter assembly, a crowfoot wrench, a pressure gage, a reducer, packings, a crimping tool, and a reusable storage container. Pressurization tool kit 9025425-21 contains the same items as kit 9025425-11 except that the spark igniter cable pressure monitor adapter assembly and the basic electrical package pressure monitor adapter assembly are deleted. In addition, kit 9025425-21 incorporates a pressure adapter swivel, an adapter pressure cap, additional packings, and an electrical package pressure monitor adapter assembly with an adjustable valve stem deflector. Pressurization tool kit 9025425-31 is the same as the -21 kit with the addition of a pressure adapter that permits the use of Tygon tubing when assembling test setups. The spark igniter cable pressurization manifold assembly incorporates pressure, vacuum, and gage connection ports, a burst diaphragm, a vent valve, two control valves, straps for support during use, a filter in the pressure connecting port, and a pressurizing hose approximately 6 feet long. The package and cable pressurizing adapter assembly is a T-fitting that incorporates a burst diaphragm and ports to interconnect the adapters, gage, and pressurizing equipment. The electrical package pressure monitor adapters are assemblies that connect to the air filler valve and to the package and cable pressure adapter or directly to the pressure gage for monitoring pressure. The crowfoot wrench is used with standard tools to torque the spark igniter cable and package air filler valves. The new electrical package pressure monitor adapter assembly in kit 9025425-21 eliminates pressure loss during monitoring and pressurization. The pressure adapter swivel provides an easy means of attaching and removing the pressurizing hose. The adapter pressure cap is used to close the 1/4-inch threaded port on the package and cable pressurizing adapter assembly during an engine test. The crimping tool is used when the spark igniter cables incorporate pressurizing tube stubs. See figure 32-2 for leading particulars of the toolkit. Instructions for using the toolkit components are in R-3825-1B and R-3825-3.

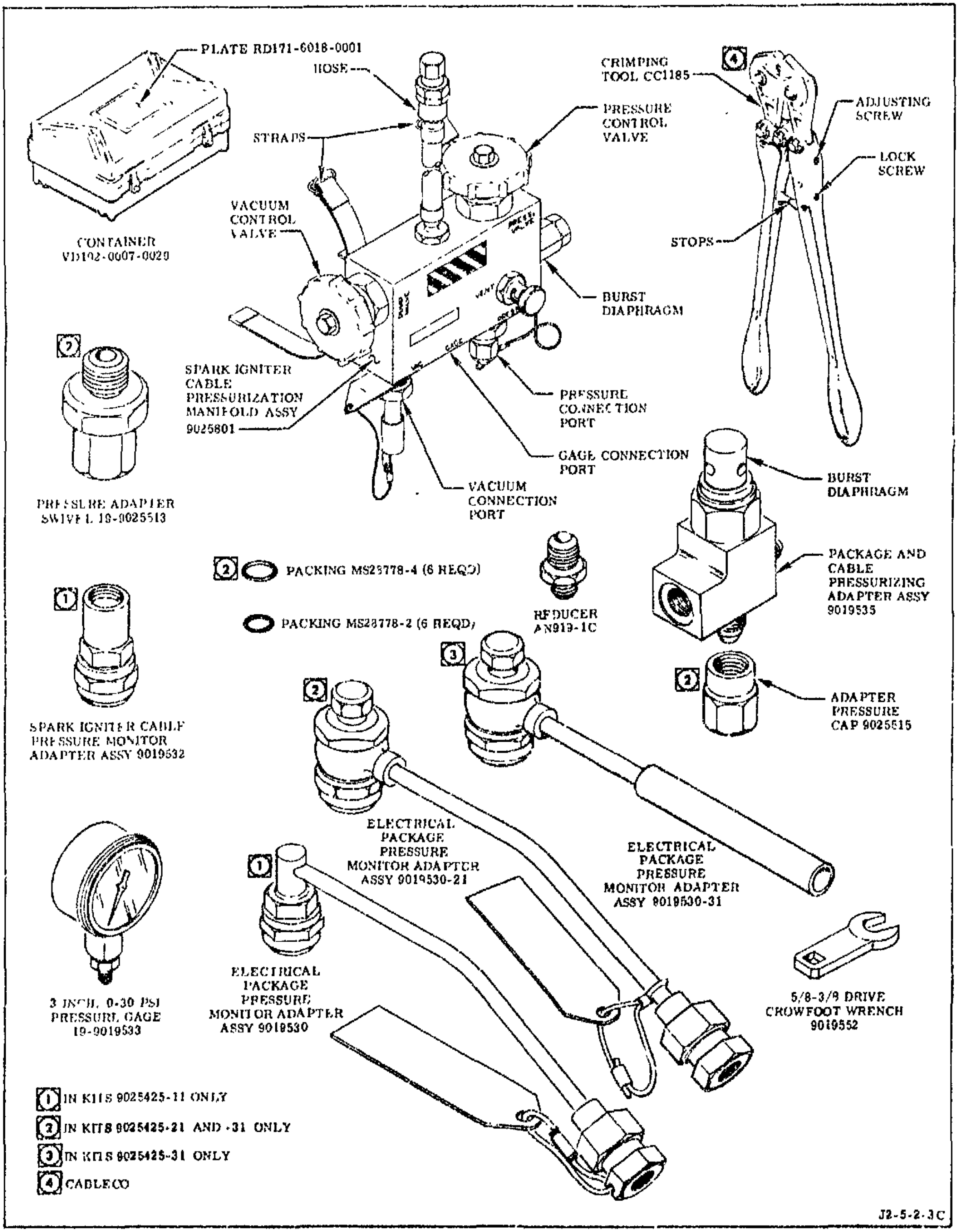


Figure 32-1. Spark Igniter Cable Pressurization Toolkit

| | |
|---|---|
| Spark igniter cable pressurization manifold | |
| Length | 7.5 in. |
| Width | 6.5 in. |
| Height | 2.5 in. |
| Operating pressure | 50 (+5, -0) psig |
| Vacuum | $10^{-5}$ mm of mercury |
| Burst diaphragm rating | 80 psig |
| Hose length | 72 in. |
| Hose bend radius | 3 in. (min) |
| Strap length | 20 in. |
| Filter rating | 10-micron nominal, 25-micron absolute |
| Electrical package pressure monitor adapter assembly | |
| Length | 5 in. |
| Inlet port | AND10050-2 |
| Pressure gage | |
| Pressurizing and monitoring | 0-30 psig |
| Package and cable | |
| Pressurizing adapter | |
| Burst diaphragm rating | 40 ±5 psig |
| Crowfoot wrench | |
| Drive | 3/8 in. |
| Length | Adds 2-in. arm. |
| Size | 5/8 in. between flats |
| Crimping tool | |
| Capacity | 1/8-in. diameter tubing |
| Length | 19 in. |

Figure 32-2. Leading Particulars

32-3. CONFIGURATION CHANGES--MANUAL EFFECTIVITY.

32-4. Modifications that are incorporated and that change configuration of the spark igniter cable pressurization toolkit are listed in figure 32-3.

| Approved ECP No. | Part No. | Incorporated in Manual Date |
|---|---|---|
| J2-512 | 9025425-11 | 7 September 1966 |
| J2-512R1 | 9025425-11 | 19 January 1967 |
| J2-610 | 9025425-21 | 2 February 1968 |
| J2-706 | 9025425-31 | 25 January 1973 |

Figure 32-3. Configuration Changes--Manual Effectivity

32-5. MAINTENANCE OF SPARK IGNITER CABLE PRESSURIZATION TOOLKIT.

32-6. Maintenance tasks required on the spark igniter cable pressurization toolkit are listed in figure 32-4. Information presented lists the tasks to be performed, when the tasks must be performed, and where data support is found. Maintenance tasks include cleaning, leak-testing the manifold, and adjusting and lubricating the crimping tool.

a. When assembling toolkit parts during maintenance, lubricate packing and threads, as applicable, for static pneumatic service. (Refer to section I.)

CAUTION

In the following procedure, the burst diaphragm diffuser must not be used as a wrenching or torquing surface since damage to the diaphragm can occur.

b. Torque burst diaphragm assemblies to 80-120 in-lb.

32-7. LEAK TESTING. Leak testing consists of pressurizing the manifold with a regulated source of gaseous nitrogen and checking for leakage at joints, connections, and components.

a. Seal manifold adapter hose with suitable plug and adapter. Torque to 4-5 in-lb.

b. With manifold PUMP VALVE hand valve closed and PRESS. VALVE hand valve open, apply 50 ±5 psig gaseous nitrogen pressure to inlet port.

CAUTION

In the following procedure, leak-test compound contacting the burst diaphragm rupture disk may result in damage to the disk.

c. Cover openings in burst diaphragm diffuser with masking tape (Federal Specification UU-T-106), or equivalent, to prevent entry of leak-test compound. Provide a small hole in tape over one diffuser opening to check for leakage. Leak-test all joints and connections with leak-test compound (MSFC-SPEC-384). Leakage is not allowable.

d. Remove protective cap and check VAC port for leakage. Leakage is not allowable.

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Inspect toolkit for completeness. | X | X | | | (See figure 32-1.) |
| Inspect manifold cables and straps for frayed or broken strands. | X | X | | | Replace cable or strap. |
| Replace manifold valves and packing. | | | | X | When leaking or difficult to operate. (Refer to paragraph 32-6.) |
| Replace manifold burst diaphragm and packing. | | | | X | When rupture disk is scratched or shows signs of deformation. (Refer to paragraph 32-6.) |
| Clean manifold, monitoring adapters, and pressurizing adapters. | | | | X | Whenever contamination of assembly is suspected or known to be contaminated. The assembly must be cleaned for pneumatic service and visually inspected to be free of any rust, scale, dirt, chips, and foreign particles. Refer to section I for applicable cleaning procedures.<br>WARNING<br>Trichloroethylene is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death. |
| Clean manifold filter and outer housing. | | | | X | Every 6 months, when restriction is suspected, and whenever disassembled from manifold. Ultrasonically clean filter with trichloroethylene (MIL-T-27602). |
| Clean manifold and pressurizing adapter burst diaphragms. | | | | X | As necessary to maintain level of cleanness. Remove burst diaphragm assembly. Disassembly of the burst diaphragm is not required for cleaning. Refer to Cleaning Burst Diaphragms in R-3825-5, Volume I and to paragraph 32-6. |

Figure 32-4. Maintenance Requirements for Spark Igniter Cable Pressurization Toolkit (Sheet 1 of 2)

| Requirements | Receiving | Prior to Use | Storage | Special | Reference/Remarks |
|---|---|---|---|---|---|
| Proof-pressure-test manifold hose. | | | | X | Every 12 months. Disconnect hose from manifold and adapter. Apply 800 ±40 psig gaseous nitrogen (MIL-P-27401) pressure for 2 minutes. No permanent deformation is allowable. |
| Leak-test manifold. | | X | | X | Every 6 months, or when leakage is suspected. (Refer to paragraph 32-7.) |
| Replace packings. | | X | | | Whenever tools are assembled to perform a task. |
| Check accuracy of pressurizing and monitoring gage. | | | | X | Every 6 months. Check gage to ensure an accuracy of ±0.5 percent of full scale. (Refer to paragraph 32-11.) |
| Adjust crimping tool. | | | | X | Whenever inadequate crimp is made. (Refer to paragraph 32-10.) |
| Lubricate crimping tool. | | | | X | As necessary when tool becomes difficult to operate. (Refer to paragraph 32-9.) |
| Inspect crimping tool jaws for nicks, burs, and sharp edges. | | X | | | Replace crimping tool. |

Figure 32-4. Maintenance Requirements for Spark Igniter Cable Pressurization Toolkit (Sheet 2 of 2)

32-8. MAINTAINING ELECTRICAL PACKAGE PRESSURE MONITOR ADAPTER ASSEMBLY. The following procedure may be used as necessary to maintain the electrical package pressure monitor adapter assembly (figure 32-5) in a serviceable condition. Whenever trichloroethylene (MIL-T-27602) or cleaning compound (MIL-C-81302) is called out in this procedure the following warning and caution apply:

WARNING

Trichloroethylene is a toxic solvent. Inhalation of its vapors or prolonged contact with the liquid can cause serious injury or death.

- Cleaning compound (MIL-C-81302) is volatile. Use in a well-ventilated area since the vapors displace the oxygen in the air, resulting in suffocation.

CAUTION

When using trichloroethylene, rubber or neoprene gloves must not be worn, since trichloroethylene dissolves these materials and leaves a residue on surface parts.

- In the following procedure, only enough holding force should be applied on the body of the adapter to remove the nut. No force should be transmitted to the inlet tube of the adapter.

a. Secure body of adapter 9019531-11 in vise using fiber or wood blocks to protect the body during removal of nut 2755-6.

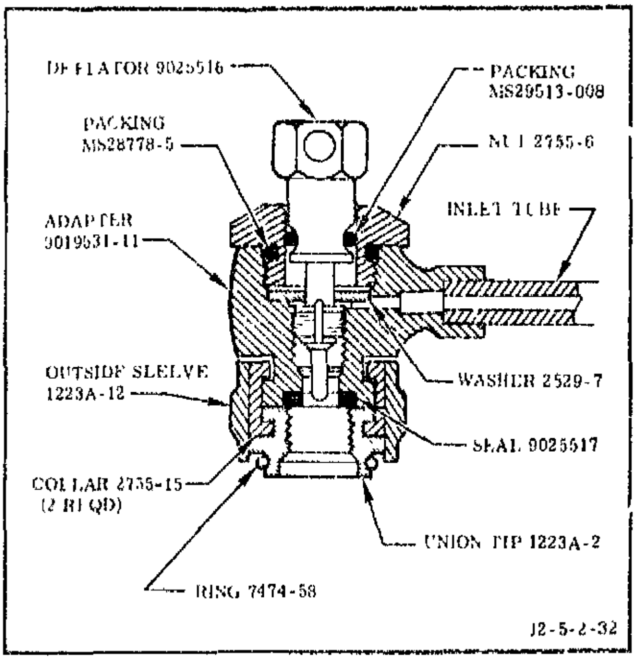


Figure 32-5. Electrical Package Pressure Monitor Adapter Assembly

b. Rotate deflator 9025516 counterclockwise until it stops, then rotate clockwise one full turn.

c. Rotate nut 2755-6 counterclockwise until it is free of the body (approximately 2 turns) while preventing deflator from turning.

CAUTION

Care must be exercised during the following procedure to prevent loss of the washer, which can easily drop out of place.

d. Rotate deflator 9025516 counterclockwise until free of body; then remove deflator 9025516, nut 2755-6, washer 2529-7, and packings as an assembly.

e. Remove washer 2529-7 from deflator 9025516 (if not already accomplished), and separate deflator from nut 2755-6. Remove packings from deflator and nut.

f. Clean nut 2755-6, including base of nut, and deflator 9025516 by handwiping. (Refer to R-3825-5, Volume I for cleaning.)

NOTE

It is preferable to replace used packings, whether defective or not. However, reuse is not detrimental unless packings are visibly damaged or are known to have failed.

g. If packings MS29513-008 and MS28778-5 are not replaced, wipe packings with a clean, nylon cloth No. 7815 (Victor Gloves, Inc) moistened with new or distilled trichloroethylene (MIL-T-27602) or cleaning compound (MIL-C-81302, Type II). Dry packings with low-pressure, filtered gaseous nitrogen (MIL-P-27401). Lubricate deflator packing MS29513-008 (Method L, R-3825-5, Volume I) and nut packing MS28778-5 (Method J, R-3825-5, Volume I) with lubricant grease RB0140-012 (Rocketdyne).

h. If packings MS29513-008 and MS28778-5 are replaced, lubricate deflator packing MS29513-008 (Method L, R-3825-5, Volume I) and nut packing MS28778-5 (Method J, R-3825-5, Volume I) with lubricant grease RB0140-012 (Rocketdyne).

i. Install packing MS28778-5 on nut 2755-6 and packing MS29513-008 on deflator 9025516.

iA. Lubricate threads of nut 2755-6 (Method A, R-3825-5, Volume I) with lubricant grease RB0140-012 (Rocketdyne).

j. Reassemble deflator 9025516, nut 2755-6, and washer 2529-7. Retain washer by positioning nut towards deflator threads.

k. Remove adapter 9019531-11 from vise. Remove ring 7474-58, outside sleeve 1223A-12, 2 collars 275515, union tip 1223A-2, and seal 9025517 from body of adapter 9019531-11.

WARNING

Compressed gas must not be used for drying or cleaning unless effective chip guarding is used and personal protection equipment is worn.

l. Clean internal threads in body of adapter 9019531-11 by agitating in trichloroethylene (MIL-T-27602) or cleaning compound (MIL-C-81302, Type II). Do not allow fluid to enter tube of adapter. Purge dry with filtered low-pressure (less than 30 psig) gaseous nitrogen (MIL-P-27401) through tube of adapter to verify there is no restriction in tube or body.

m. Obtain assembly of deflator 9025516, nut 2755-6, and washer 2529-7 and position washer concentric with deflator.

n. Install assembly obtained in step m into body of adapter by turning deflator 9025516 and nut 2755-6 simultaneously clockwise until packing friction is observed. During installation check for any binding due to difference in thread pitches of deflator and nut.

CAUTION

In the following procedure, only enough holding force should be applied on the body of the adapter to remove the nut. No force should be transmitted to the inlet tube of the adapter during torquing of nut 2755-6.

o. Secure body of adapter 9019531-11 in vise using fiber or wood blocks to protect the body, and torque nut 2755-6 to 20-25 in-lb.

p. Rotate deflator 9025516 fully counterclockwise and clockwise at least 2 times to verify proper assembly and to seat deflator packing. Leave deflator in full clockwise position.

q. Install seal 9025517 in body of adapter 9019531-11. Use new seal if old seal is damaged. There must be at least 1/32-inch radial clearance between outside diameter of deflator and inside diameter of seal.

r. Reinstall union tip 1223A-2, 2 collars 2755-15, outside sleeve 1223A-12, and ring 7474-58 on body of adapter 9019531-11. Rotate deflator to full counterclockwise position.

s. Test adapter 9019530-21 or -31 as follows:

(1) Obtain an air filler valve RD284-001-0001 and rotate swivel nut clockwise to close metal-to-metal seat.

(2) Install adapter on air filler valve.

(3) Cover adapter and air filler valve with a barrier, and proof-pressure test adapter by pressurizing to 90 ±5 psig for 2 minutes using gaseous nitrogen (MIL-P-27401). There must be no deformation of components. Depressurize adapter to zero psig.

(4) Leak test adapter by pressurizing to 30 (+5, -0) psig for 2 minutes using gaseous nitrogen. Apply leak-test compound (MSFC-SPEC-384) to all areas of the adapter where pressurizing gas could escape. Leakage is not allowable. Depressurize adapter to zero psig.

(5) Rotate swivel nut 1-2 turns counterclockwise on air filler valve, and rotate deflator on adapter to the full clockwise position, or until valve core is fully depressed.

(6) Apply gaseous nitrogen pressure to the adapter and check for audible flow past the metal-to-metal seat of the air filler valve.

(7) If flow exists past the metal-to-metal seat of the air filler valve, adapter can be considered satisfactory. Depressurize adapter to zero psig, turn deflator fully counterclockwise, disconnect pressurizing equipment, and disconnect adapter from air filler valve.

(8) If no flow or extremely restricted flow (seepage past metal-to-metal seat) exists, the reason may be one or a combination of the following problems:

(a) The flat on the deflator is blocked or it is not the correct size. The existence of this problem can be verified by accomplishing steps a through d to remove deflator. Check deflator and body of adapter to see if a foreign object exists, or check dimension from flat to major thread diameter opposite the flat, which should be 0.255 to 0.260 inch. Correct any discrepancy that may exist, reassemble adapter, and retest in accordance with step s.

(b) The deflator chamfer is bottoming out in body of adapter. The existence of this problem can be verified by separating air filler valve and adapter, pressurizing adapter with gaseous nitrogen not to exceed 35 psig, and checking that flow exists past the deflator. Correct any discrepancy that may exist, reassemble adapter, and retest in accordance with step s.

(c) The inside diameter of seal 9025517 is contacting the outside diameter of the deflator tip. The existence of this problem can be verified by separating the air filler and adapter assembly, and by removing ring, outside sleeve, collars, and union tip. Check for at least 1/32-inch radial clearance between deflator and inside diameter of seal. Replace seal if clearance is not adequate, and recheck for radial clearance. Reinstall union tip, collars, outside sleeve, and ring. Retest adapter in accordance with step s.

32-9. LUBRICATING CRIMPING TOOL. Disassemble tool by removing bolts and pins; remove any burs from bolts, pins, and joints; and lubricate (Method W, R-3825-5, Volume I) with lubricant grease RB0140-012 (Rocketdyne). Assemble and tighten bolts to remove end play. (Bolt connecting jaw to handle, containing adjusting screws, has left-hand threads.)

NOTE

Excessive tightening of bolts affects ease of tool operation.

32-10. ADJUSTING CRIMPING TOOL. The crimping tool is adjusted to crimp a 1/8-inch diameter CRES tubing (MIL-T-8808, Composition 321 or 347, Type 1) with a 0.035-inch wall thickness to a total thickness of 0.050 ±0.005 inch. Use sample tube when adjusting tool. Do not adjust crimping tool by grinding handle stops.

a. With crimping tool open (handle spread apart), loosen locking screw 1-2 turns. (See figure 32-1.)

b. Adjust total thickness of crimp by turning adjustment screw counterclockwise to increase, or clockwise to decrease.

c. Crimp sample tube to 0.050 ±0.005 inch. Crimp must be obtained with stops in contact with each other. Repeat step b until correct crimp is obtained; then tighten lock screw.

32-11. CHECKING PRESSURE GAGE. See figure 32-6 for pressure gage calibration check requirements. The gage listed in figure 32-6 is used in a pneumatic system.

| Part Number | Nomenclature | Range Accuracy (± Full Scale) | Test Standard[(a)] Minimum Accuracy (± Full Scale) |
|---|---|---|---|
| 19-9019533 | Pressure Gage | 0-30 psig (0.5%) | 0.2% |

(a) Range of test standard must be at least 100% but not more than 125% of range of instrument being tested.

Figure 32-6. Pressure Gage Calibration - Check Requirements

MANUAL DATA SUPPLEMENT RECORD

| Supplement Number | Dated | Description | Supplement Status |
|---|---|---|---|
| R-3825-5 Vol II-18 | 19 February 1968 | Changes procedure for function-testing gas generator high-low temperature cutoff panel. | Incorporated |
| R-3825-5 Vol II-19 | 22 March 1968 | Changes requirement for checking the standard glass leak, and changes procedure for calibrating the turbine overspeed trip. | Incorporated |
| R-3825-5 Vol II-20 | 3 May 1968 | Adds requirement to perform a proof test on propellant inlet duct handlers 9016784 and 9016785 prior to their use in a stacked Saturn vehicle. | Incorporated |
| R-3825-5 Vol II-21 | 28 August 1968 | Adds Forward Handling Sling G4042 MD1 data. | Incorporated |
| R-3825-5 Vol II-22 | 25 June 1968 | Changes securing procedures for the liquid nitrogen service unit, and adds a caution. | Incorporated |
| R-3825-5 Vol II-23 | 15 May 1969 | Provides for lubricating the yoke bearing and slide lock of Engine Handler G4064 when an engine is installed. | Incorporated |
| R-3825-5 Vol II-24 | 24 June 1969 | Adds repair procedure for Microsol protective coating. Changes maintenance requirements of G4042MD1 adapter. Changes maintenance requirements of sequence controller handler. Adds requirement to inspect handlers, adapters, and slings for damaged protective coating. Changes maintenance requirement for internal access platform and base. | Incorporated |
| R-3825-5 Vol II-25 | 23 October 1971 | Adds requirements that limit lifting capacity of Engine Components Installer G4072MD1. | Not incorporated due to equipment being modified by MD2 change. |
| R-3825-5 Vol II-26 | 13 June 1972 | Changes pressure limit for pressurized gases to be considered low-pressure. | Incorporated |

## MANUAL DATA SUPPLEMENT RECORD

| Supplement Number | Dated | Description | Supplement Status |
|---|---|---|---|
| R-3825-5 Vol II-27 | 2 October 1972 | Changes lubricant used on Engine Components Installers G4071 and G4072 boom and turntable. | Incorporated |
| R-3825-5 Vol II-28 | 19 October 1972 | Changes solvent used to remove existing lubricant and drying requirements when relubricating components of the components installer sets. | Incorporated |
| R-3825-5 Vol II-29 | 13 April 1973 | Adds warnings for handling specific materials. | Incorporated |
| R-3825-5 Vol II-30 | 16 April 1973 | Changes leak-test compound (MIL-L-25567) to leak-test compound (MSFC-SPEC-384). | Incorporated |
| R-3825-5 Vol II-31 | 4 September 1974 | Adds OTBV closing line closure test kit EWR-225308; MOV, MFV, and OTBV drying kit EWR-225309; and MRCV and GG valve drying and leak test kit EWR-230094. | Replaced by R-3825-5 Vol II-32 |
| R-3825-5 Vol II-32 | 12 September 1974 | Corrects part number and adds redundant timer adapter EWR-220289. | Replaced by R-3825-5 Vol II-33 |
| R-3825-5 Vol II-33 | 14 October 1974 | Changes part number of nut RD114-8005-2004 to nut RD114-1002-0004 and adds leak testing oxidizer feed and purge systems kit EWR-225310. | Incorporated |